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SHARP PC-3201 BENCHTESTED

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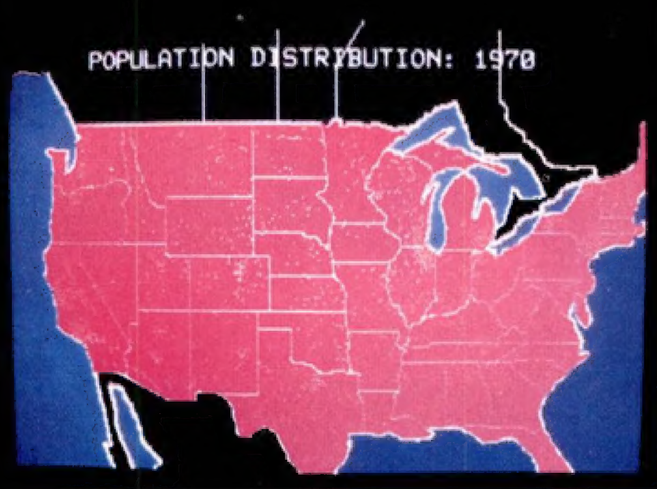
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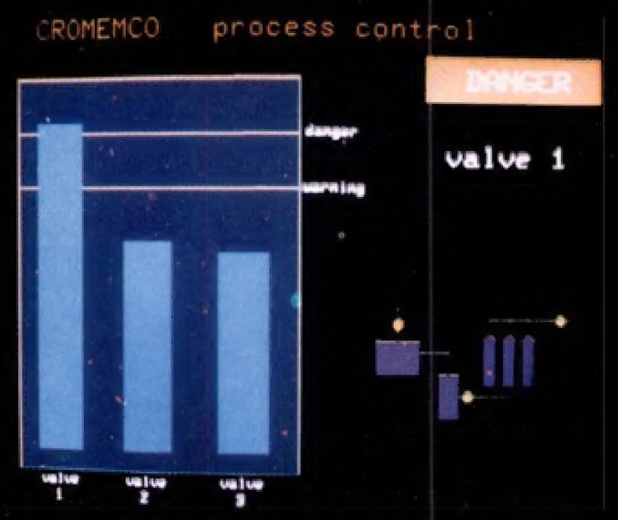
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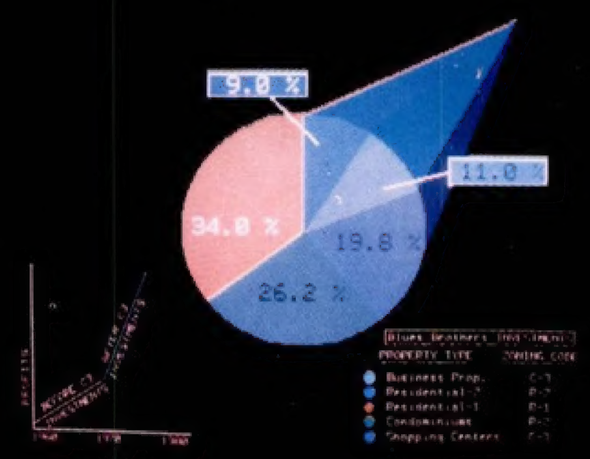
Demographic Display



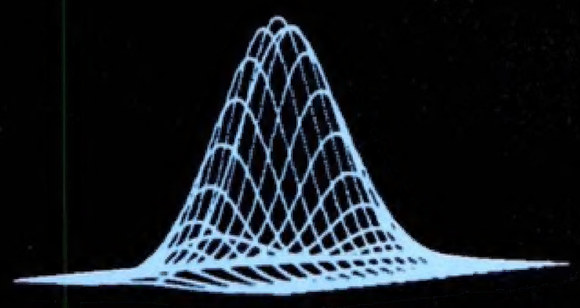
Management information



Control system display



3-D display with angled labels



3-D plots



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Up to 16 colours can be displayed simultaneously, from a choice of 4069. Areas can be filled with colour, windows created, graphs plotted, etc—all under control of simple Basic, Fortran or Assembler functions.

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With its high point resolution, colour map selection, dual page windowing function, automatic fill mode, and NTSC or PAL broadcast compatibility, the most demanding requirements for a video interface can be met. The SDI provides a choice of 4096 individual colours and up to 754 by 482 point resolution. Its different modes of operation include bit or nybble mapped displays with varying levels of resolution, and window effects requiring as little as 12k data storage.

RGB-13 Colour Monitor

The Cromemco RGB-13 Colour Monitor has been specially designed for optimum colour graphics performance when used with Cromemco's SDI video interface. It includes a fine-pitch 13" CRT with a high-precision electron gun, internal magnetic shielding, and implosion protection band. The monitor combines alphanumeric character generation with colour graphics and high resolution, to give an overall performance vastly more superior than conventional colour TVs or CRT terminals.

Graphics Software

Cromemco's graphics software package provides an interface to Fortran IV, Ratfor, Macro Assembler, 16K Extended Basic and 32K Structured Basic. It is written for ease of use and takes full advantage of the RGB-13 monitor's special graphics facilities. Thus it is efficient, flexible and extremely fast. The package contains routines to change the colour map, scale the display area, draw dots, lines and circles, display text, and fill areas with colour.
Screen addressing can be by absolute or relative co-ordinates.

Model Z2H/GS Graphics System

The Z2H/GS is a special configuration of the Z-2H Hard Disk computer which includes full graphics capability and software. Yet at under £8,000 it's a fraction of the cost of comparable systems. It is ideal for applications in medical imaging, computer-aided instruction, pattern recognition, and the television industry.

The Z2H/GS includes a Z-80A processor, 64k of RAM memory, integral 11 megabyte hard disk, RGB-13 colour monitor, 2 floppy disks, printer interface, RS-232 serial interface, and graphics software package.



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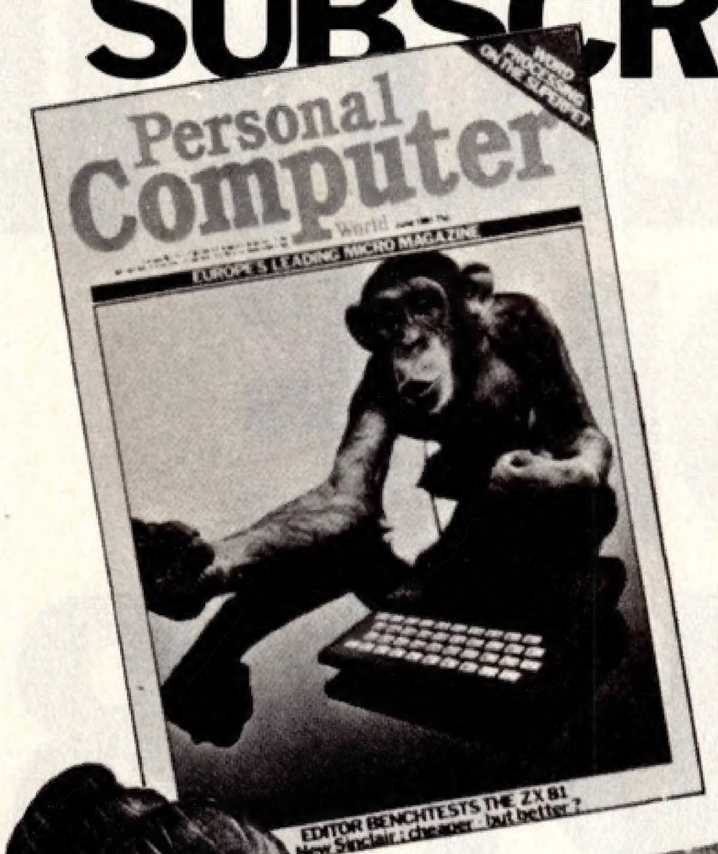
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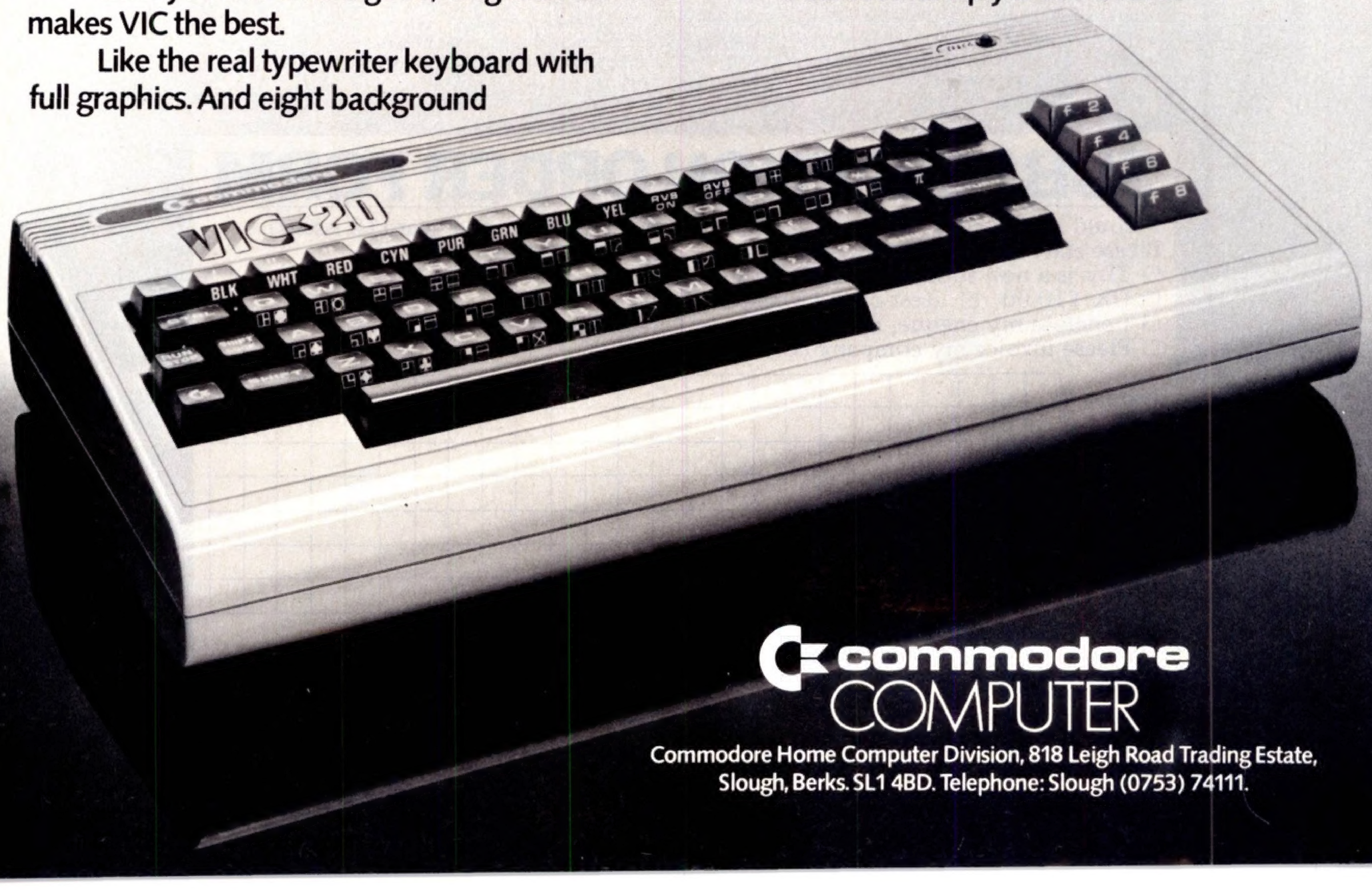
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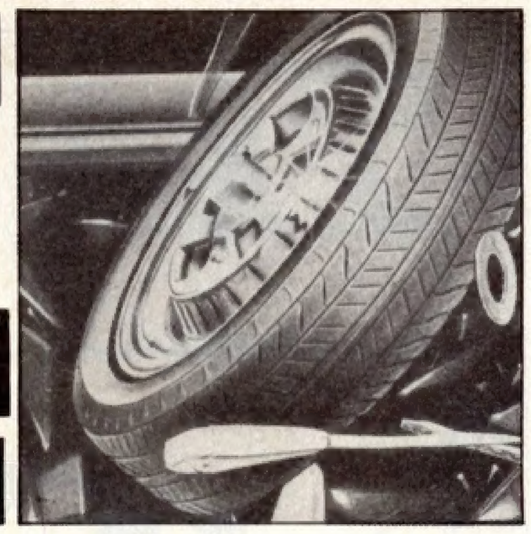


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Volume 4 No 7 July 1981



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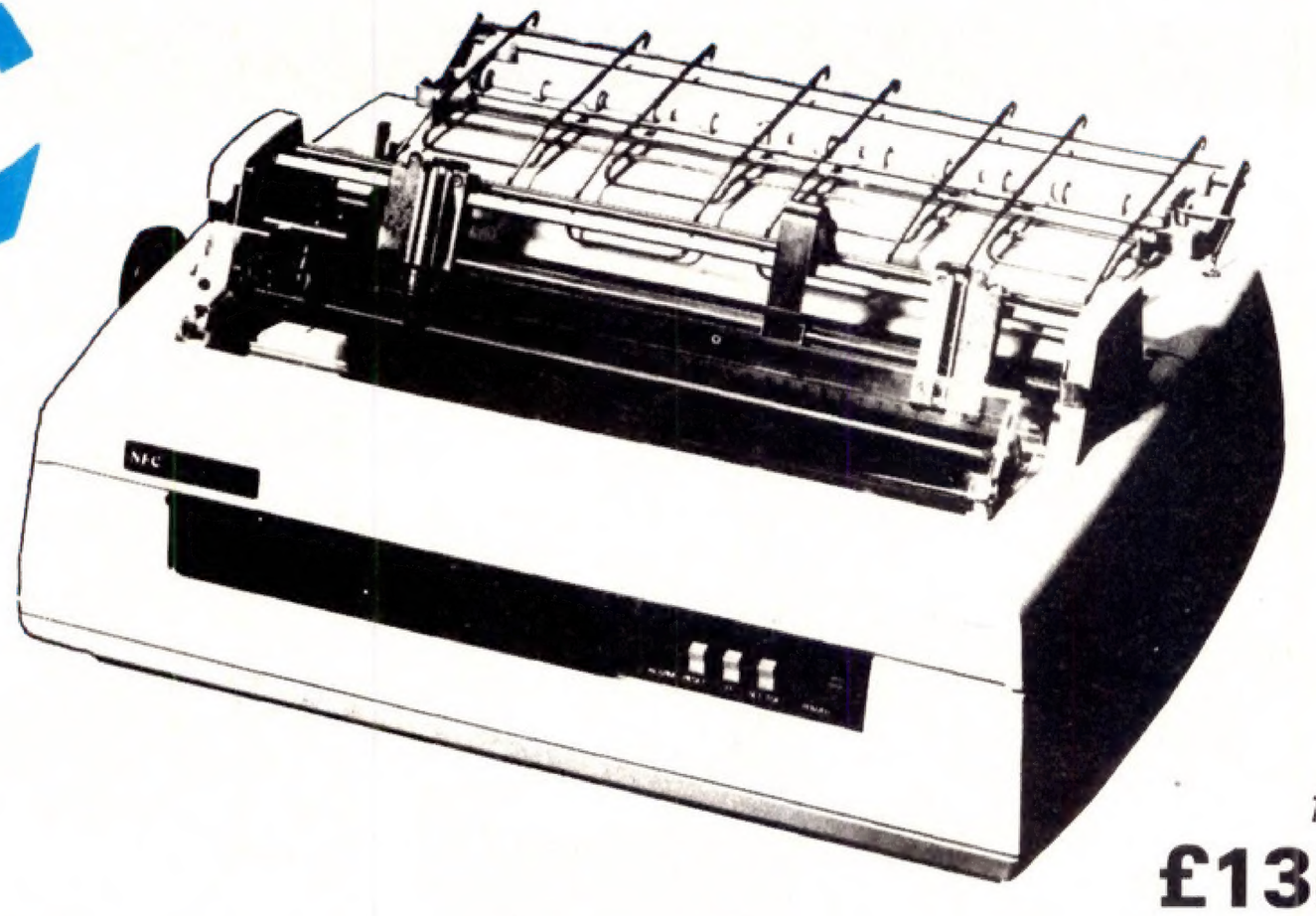
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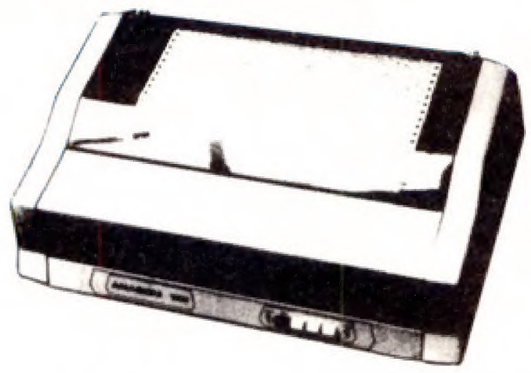
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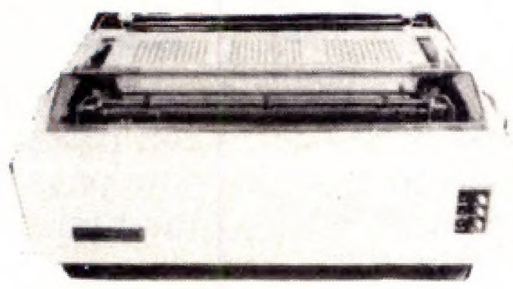
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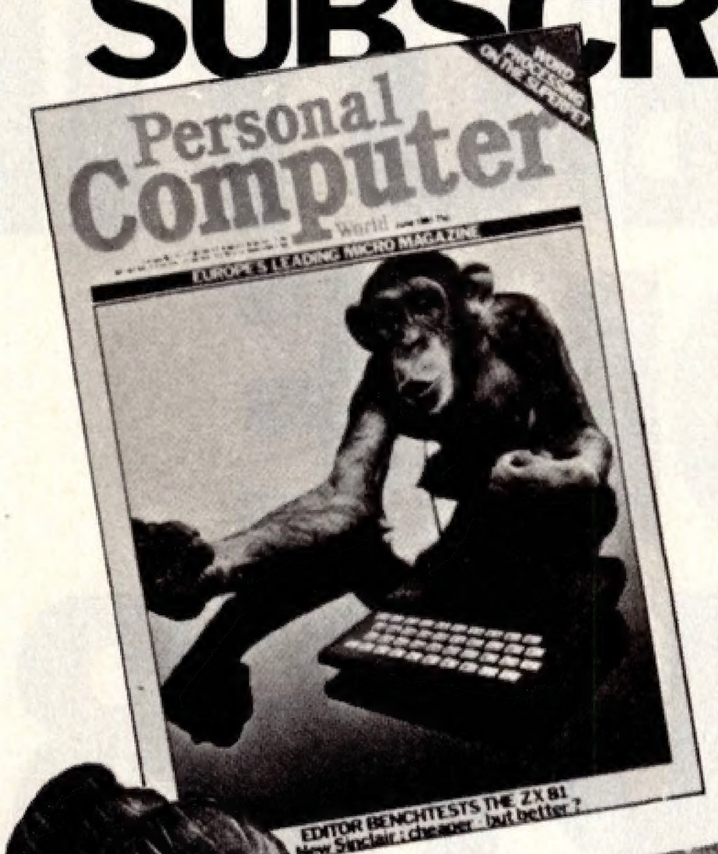


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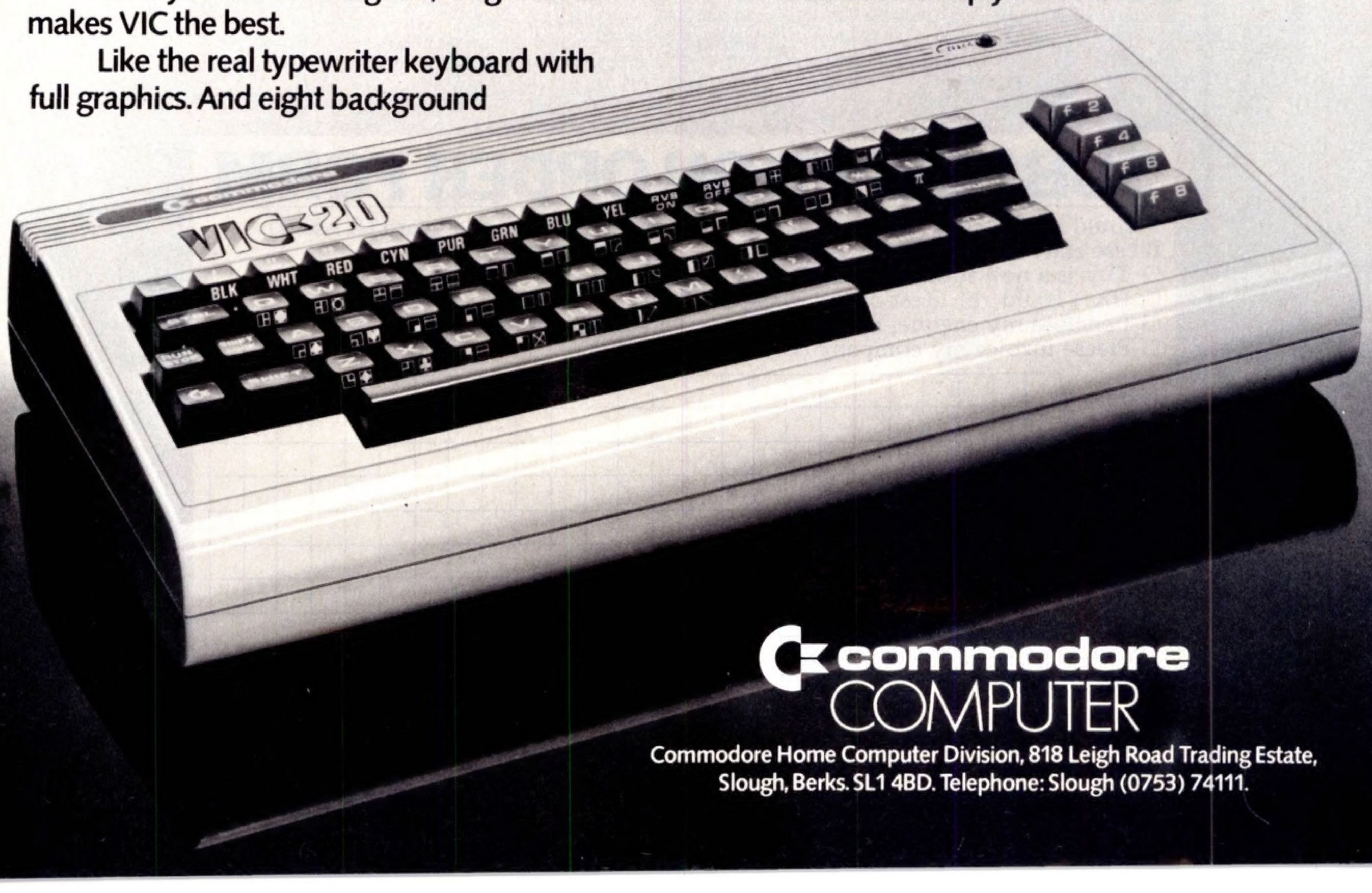
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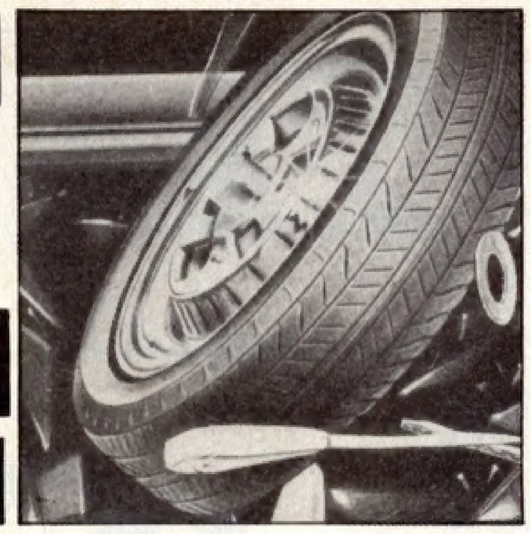


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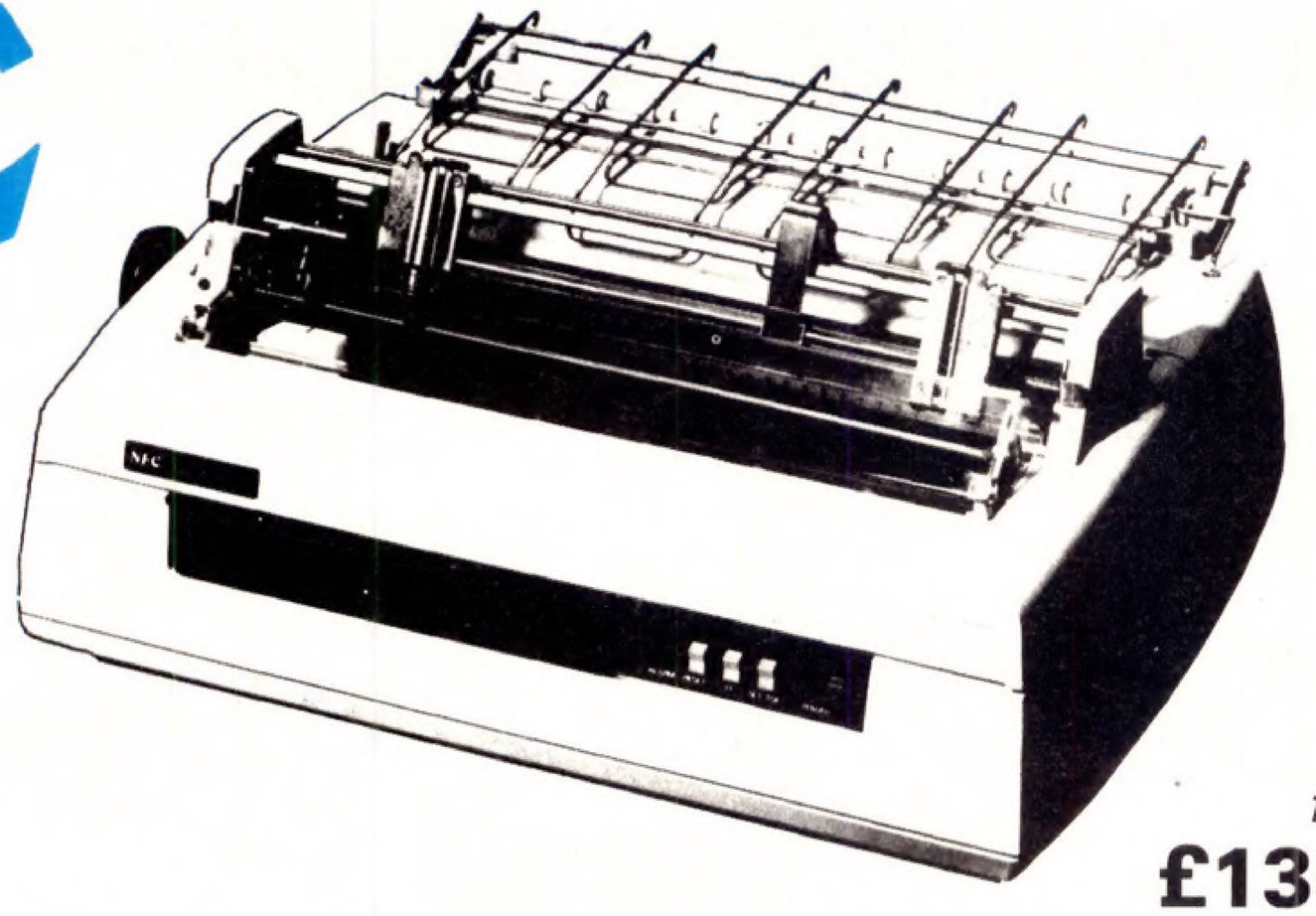
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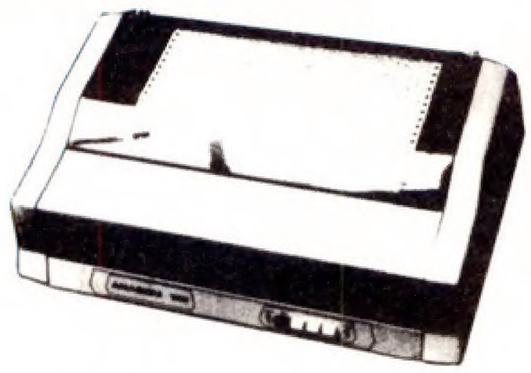
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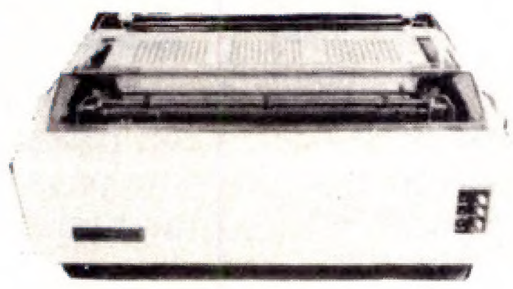
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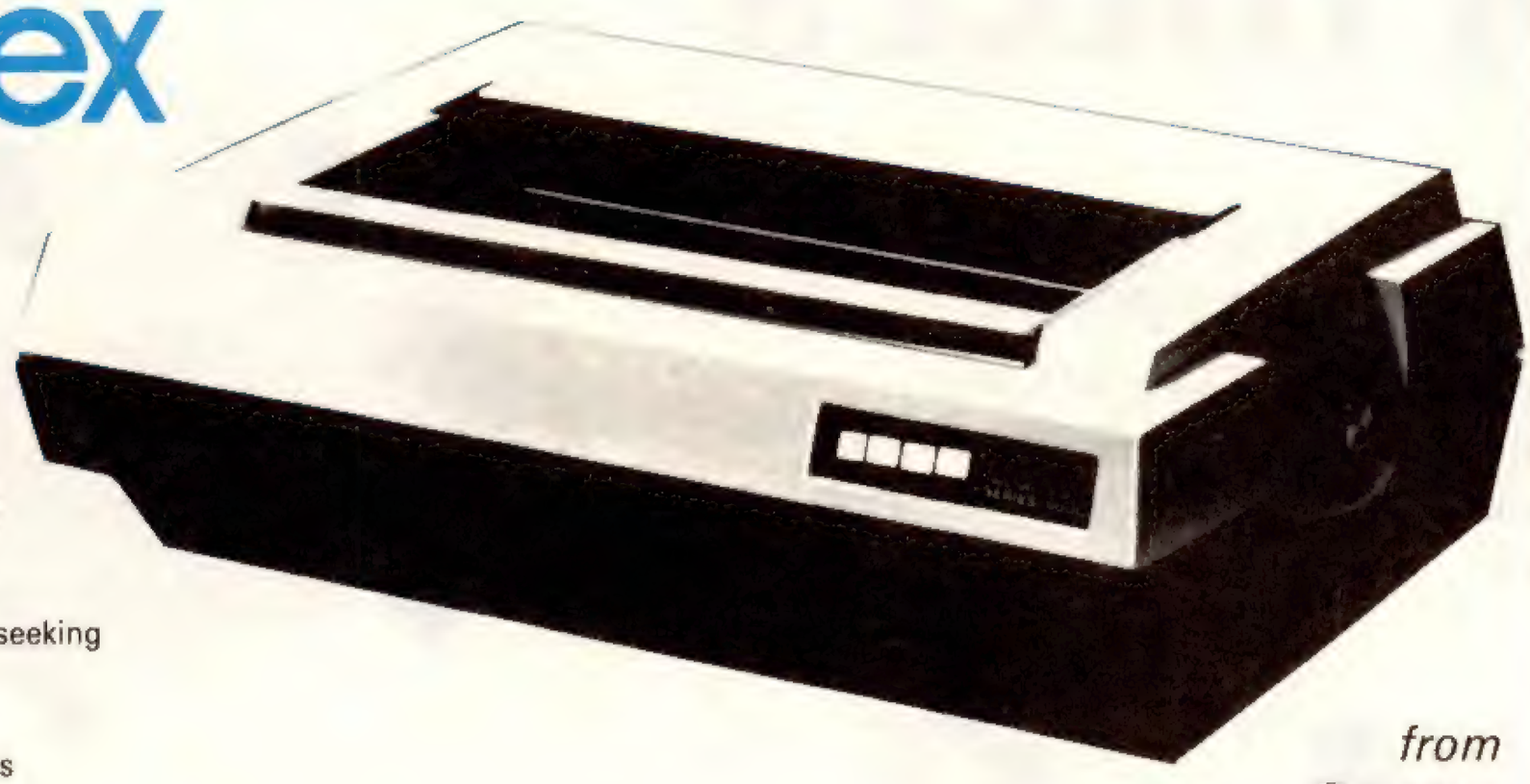


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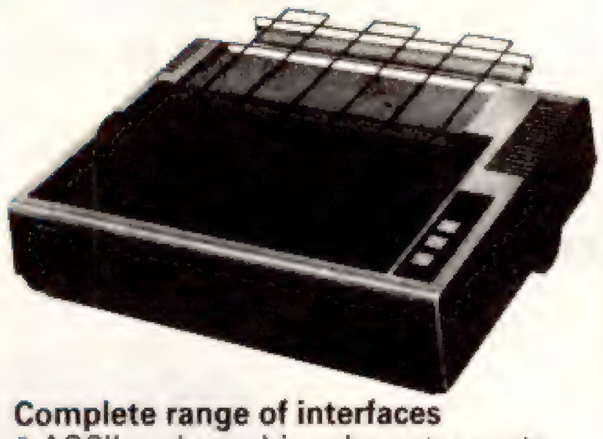
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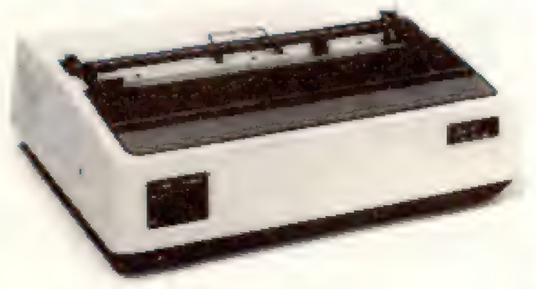
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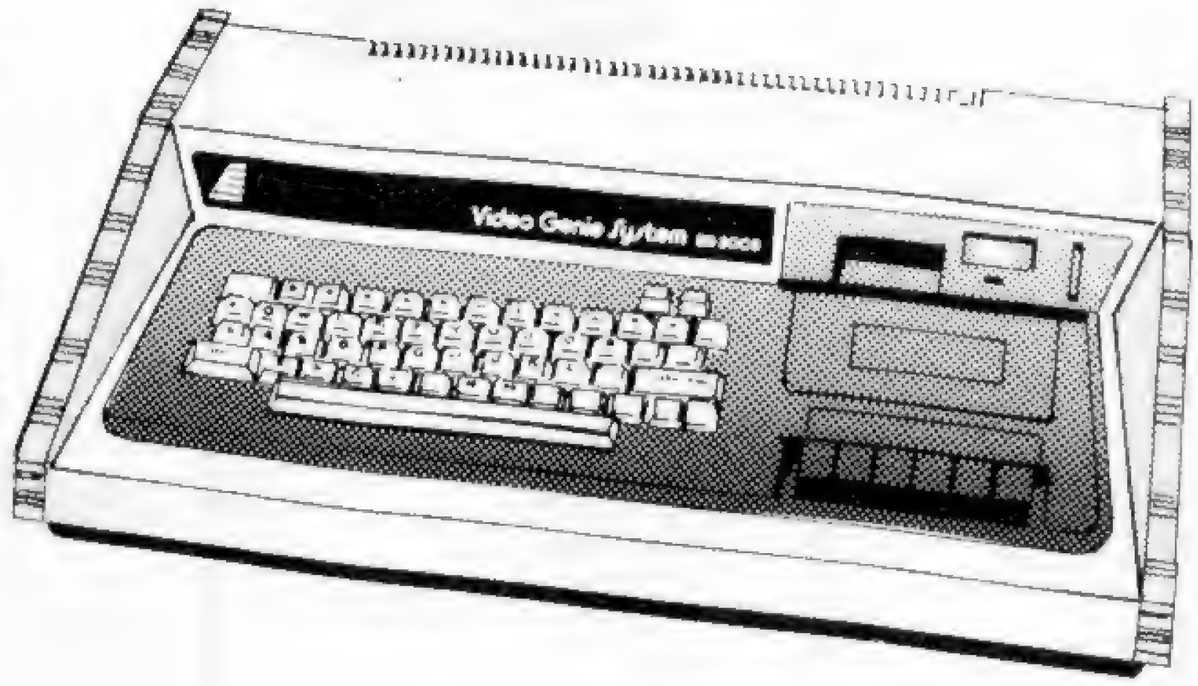
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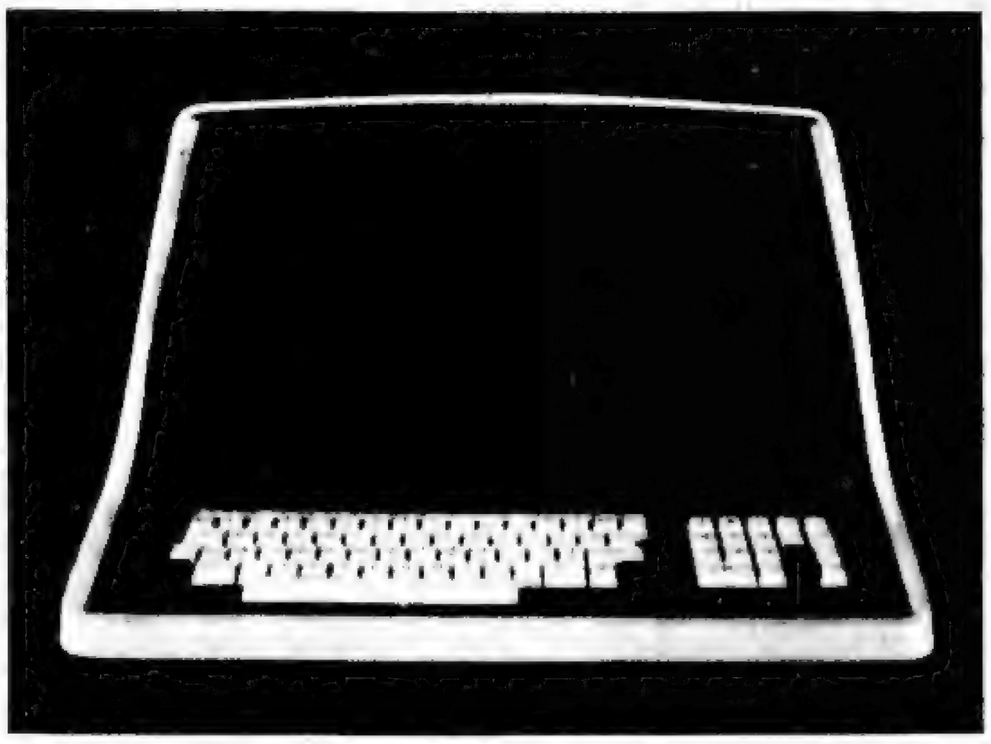
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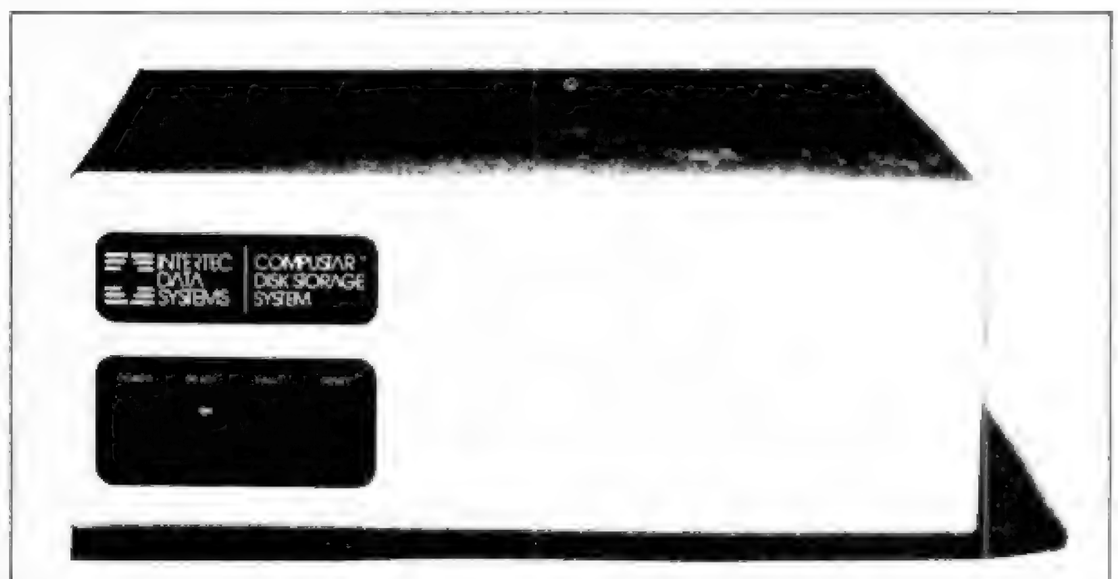
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Functional characteristics
The CompuStar 10 megabyte Disk Storage System (DSS) consists of read/write and control electronics, read/write heads, a track positioning mechanism, a spindle drive mechanism, dual disks, an air filtration system, and our exclusive 255 user controller — all packaged in a compact desktop enclosure. Although designed primarily to accommodate multiple CompuStar Video Processing Units (described at left), the unit can easily be connected to a single Super-Brain Video Computer System to facilitate additional disk storage. When used with CompuStar VDUs, however, the integral Z80 based controller will permit up to 255 users to "share" the resources of the disk with minimal CPU response degradation.

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The recording media consists of a lubricated thin magnetic oxide coating on a 200mm diameter aluminium substrate. This coating formulation, together with the low load force/low mass Winchester type flying heads, permits reliable contact start/stop operation. Data on each disk surface is read by one read/write head, each of which accesses 256 tracks.





SYSTEMS.1

Hardware

Processor	:	Z-80A at full 4 MHZ
Memory	:	64 K RAM Standard
Disk Storage	:	One 77-track drive, 5¼" disks, soft-sectored. 750 K bytes per drive. One 5 Megabyte ST506 hard disk
Display	:	12" Green phosphor Monitor 25 lines x 80 characters 240 x 100 Graphics format Screen attributes including inverse, video, blink and underline in any of 8 intensities
Keyboard	:	Microprocessor keyboard Selectric style Lefthand function keycluster Righthand numeric keycluster 23 relegendable function keys
I/O	:	Both serial and parallel

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03= A/C RECEIVABLES
04= PURCHASE INVOICES
05= A/C PAYABLES
06= STOCK CONTROL
07= ORDER CONTROL
08= BANK UPDATES
09= SALES LEDGERS
10= PURCHASE LEDGERS
11= INCOMPLETE RECORDS
12= USER DATABASE AREA
13= PRINT CUSTOMER STATEMENTS
14= PRINT SUPPLIER STATEMENTS
15= PRINT AGENT STATEMENTS
16= PRINT TAX STATEMENTS
17= RUN SEPARATE PROGRAMS
18= CHANGE VOCABULARY
19= PRINT YEAR AUDIT
20= PRINT PROFIT/LOSS ACCOUNT
21= DISK DIRECTORIES
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WHICH OPTION

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Within the limits of twelve fields and 256 characters per record, any file architecture can be designed with complete freedom over the linguistic conventions assigned to each field. The file can then store 32000 records which can be searched by the random access number (retrieved in less than one second) or sequentially comparing for left field parts, field-inkeys, or parts of record, and then changed, printed, deleted, skipped.
GRAMA (WINTER) LTD/G.W. COMPUTERS LTD are the producers of this package which is unequalled for its level of total integration, linguistic flexibility and maximised disk/memory conservation.
Author Tony Winter (M.D.; B.A. LIT; B.A. HON. PHIL; AND LECTURER)
Price of the package is 975.00 (excluding menu items 19, 20, 22, 23) or 1075.00 for the full package (23 available end year, 19, 20, 22 being currently included). Requires MBASIC-80 and runs only on hardware on our price list.

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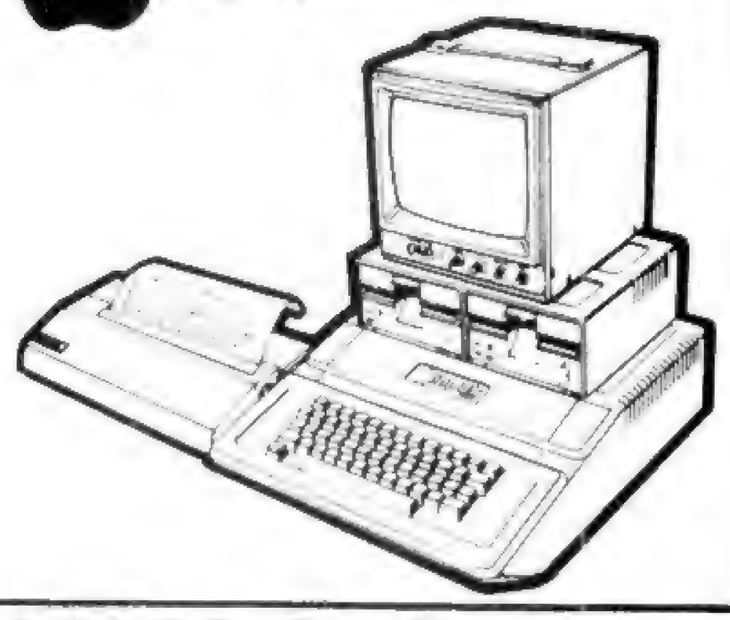
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Utilises Z80, 12k level II Basic, Integral Cassette Deck, UHF, O/P, 16k RAM, all TRS80 features. Simply plug into monitor or UHF with VU meter

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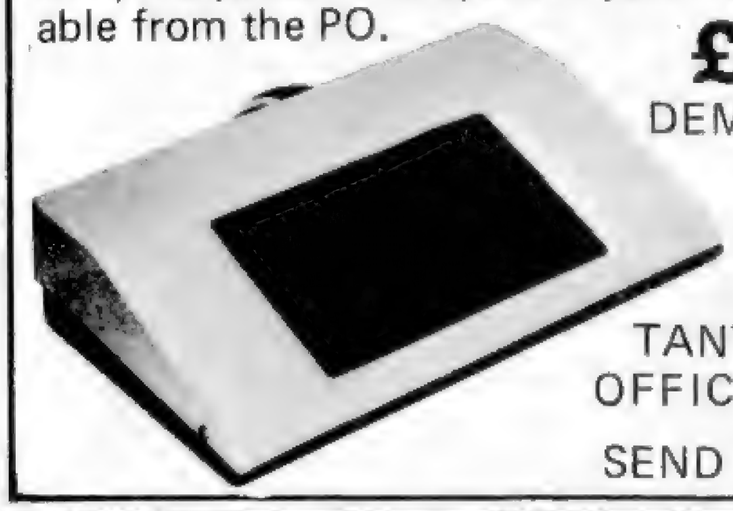
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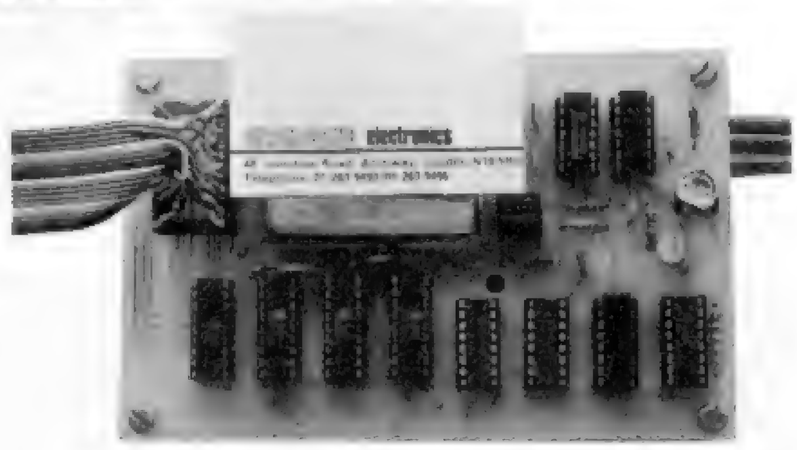


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INNOVATIVE

TRS-80 SOFTWARE

FROM THE PROFESSIONALS

LDOS

First there were the TRSDOS's, 2.0, 2.1, 2.2 and 2.3. Then came Newdos+, essentially a patched version of the TRSDOS's but with a number of very useful commands and utilities added. Then VTOS 3.0 and VTOS 4.0. These constituted a departure from the earlier DOS's and featured Device Independence so that devices such as the keyboard, printer, VDU and disk drives could interact directly together. Then came Newdos80 which is a rewrite of Newdos+, adding new utilities and new Basic commands, its main features being the ability to mix different capacity drives on the same cable and the ability to use variable length records. Now from LOBO International comes LDOS, the fifth generation disk operating system for the TRS-80 microcomputer. It combines most of the advantages of the preceding disk operating systems and unlike some of them, is accompanied by a complete and readable set of documentation, which includes a Technical Section containing relevant addresses.

It is impossible to describe all of the features of LDOS in an advertisement. For instance it includes no less than 35 library commands as follows:—

APPEND	COPY	DEVICE	DIR	DO	FILTER	KILL
LIB	LINK	LIST	LOAD	MEMORY	RENAME	RESET
ROUTE	RUN	SET	SPOOL	ATRIB	AUTO	BOOT
BUILD	CLOCK	CREATE	DATE	DEBUG	DUMP	FREE
PROT	PURGE	SYSTEM	TIME	TRACE	VERIFY	XFER

All of the useful abbreviations in Newdos are included and the System Commands in Basic (CMD) now number eleven. A program called LBASIC/FIX is included, with which the normal TRSDOS Disk Basic may be patched to include a number of new commands and features. A Job Control Language is included and in fact is one of the most powerful features of LDOS. It allows the user to compile a sequence of commands or key strokes for later execution as a chain, with or without user intervention. There are too many new features to list them herein, but examples are: The ability to provide an audible signal, output through the cassette port. To flash or blink a one line message on the video display. A WAIT feature is included so that the machine can be put into a "sleep" state until such time as the system clock matches the time specified. And so on!

Hard disks in addition to single/double density, single/double sided, 8" and 5¼" floppies are supported although they may, of course, require hardware modifications. Utilities included in the package are:

BACKUP	COMMAND FILE	FORMAT	LCOMM
PATCH	RS232	KEY STROKE/MULTIPLIER	PRINTER FILTER

A Basic Renumber facility is included, as is a Basic Cross Reference function. Both are similar to the ones in Newdos+ and Newdos80. Most of the utilities are library commands which were existent in the previous DOS's, have been improved with the addition of new functions or facilities.

The prime development team of LDOS consisted of no less than 8 first rank programmers and they had the support and advice of six other well known programmers. They have done an excellent job to bring to the user what must be the best disk operating system so far produced for a microcomputer, which is destined to become the Standard DOS.

LDOS is totally upward compatible with TRSDOS, that is to say LDOS will be able to copy files and programs from TRSDOS disks onto LDOS formatted disks. As they are competitive disk operating systems, it is not suprising that the manual states that disks created under Newdos are not guaranteed to be compatible with LDOS, but we have not experienced any difficulty. We have done some work on investigating the compatibility of LDOS and the Video Genie and at the time of going to press we have found no incompatibilities. LDOS appears to run on the Video Genie without any problems at all. LDOS is compatible with either the Tandy or Electric Pencil lowercase modifications and Scripsit. LDOS is available for the Model I and Model III. A Model II version will be available shortly.

LDOS .....£85.00 **plus** VAT and £1.50 P&P.

TRS-80 & VIDEO GENIE SOFTWARE CATALOGUE £1.00 [**refundable**] plus 50p postage.

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COMPAK

The title of this program is a composite word which may be interpreted in two ways, either as standing for COMplete PAcK of programmer's aids or as standing for one of the principal features of the program, namely the ability to compress Basic programs to a bare minimum. The suite is made up of four broad categories of utilities. In the aggregate they comprise a complete utility containing every foreseeable feature that a Basic programmer could require. It is written by Nigel Dibben in his usual efficient way and some indication of the complexity and completeness of the program is shown by the fact that even Dibben has been working on it for some number of months!

Up until now, very useful utilities have been sold by us separately, and, of course, we will continue to do so, but for some time it has become obvious that there is a market for a utility program that does everything. Whilst the author was working on this concept, we asked him to include a program which would compress Basic programs over and above the usual simple removal of spaces and REM statements. Actually the original idea for the compression of programs came from software which has been written for the Model II and which is featured in our catalogue under the name SKRUNCH and COMPRESS. The resulting program is, as we have said, a complete programmer's aid for the serious Basic programmer.

The complete program occupies 7 or 8K of RAM. Although this is no problem to the disk user, it may well be to the 16K tape user. In order to get over this difficulty (and incidentally to save money for users who have some of the utilities already) the program is available in two parts in addition to being available in the whole. The two parts are deliberately sold at the same price and at a price such that the sum of them is equal to the composite. Thus the customer does not lose from buying his program in two sections. The program is split so that COMPAK1 contains the compression and general purpose sections. COMPAK2 contains the debug, edit and general purpose sections. COMPAK contains all of the foregoing. All are compatible with both Level II Basic and Disk Basic and can be supplied either on tape or disk. The disk version contains all three programs.

Space does not allow us to describe COMPAK at any length. It is, of course, fully described in our catalogue, but briefly, split into its various sections, the features are as follows:—

COMPRESSION: Removes all redundant characters or blanks including non-used GOTO statements after THEN, redundant colons, redundant quotation marks, etc. After all redundant characters have been removed the program may be packed so that all lines that can be syntactically joined together will be. Further packing may also be carried out, the effect of which is to make the program almost unreadable but still workable.

DEBUG: Over 12 DEBUGing features are included which enable the program to be traced through step by step or line by line. Breakpoints may be inserted and the contents of variables may be displayed all the time. When an error is found the Edit mode may be entered immediately and automatically. Essentially, the DEBUG feature permits the programmer to find even the most hidden of bugs.

EDITING: Includes a complete user definable shorthand for shifted keys. Occurances of strings and variables may be found and counted. They may also be found and a wait executed so that the user may enter Edit or whatever. The find feature may be extended so that it will automatically find the occurrence and replace it with another user defined statement or string. Lines may be joined together with the automatic insertion of a colon. Lines may be checked for incorrect referencing and marked accordingly. Lines may be copied one to the other. Programs may be appended one to the other; in other words, a block is inserted after the current program so that another may be fed in and then the both joined together. An unusual feature is the ability to decode PACKED strings which contain machine language or graphics code.

GENERAL PURPOSE: A complete renumbering function together with the ability to change the renumbering increment in mid-program. A status report displays the space used by all relevant parts of the program such as arrays and variables plus of course the program itself. A Rescue feature is included so that "lost" Basic programs may be recovered. A lower case switch may be initiated so that lower case characters are printed out rather than the shorthand previously described.

We would emphasise that the above is only a synopsis of the features of this extensive program. We are not aware of any incompatibilities with the current Video Genies.

Level II tape: Compak1 or Compak2 .....**£15.00**
Level II tape: Compak **£30.00**
Disk version: All three programs **£33.00**
All prices are exclusive of VAT. Add 75p for P & P.

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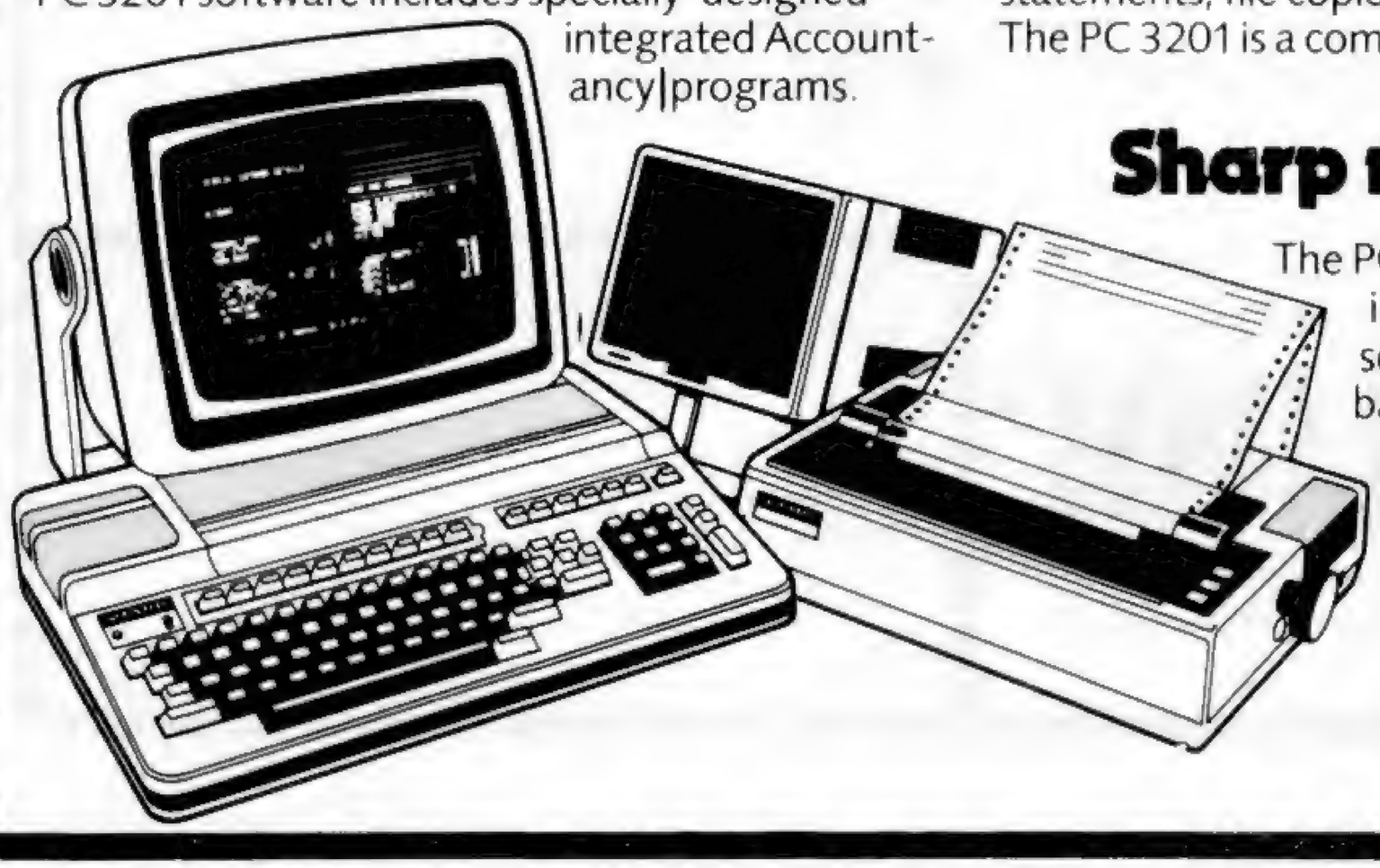


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- Up to 3 copies
- Pin feed
- Self testing

INTERFACING for most systems

- Standard: Centronics
- Options: RS232C, PET 2001 TRS-80, Apple II, IEEE-488

OPTIONAL EXTRA

- Plain paper feed

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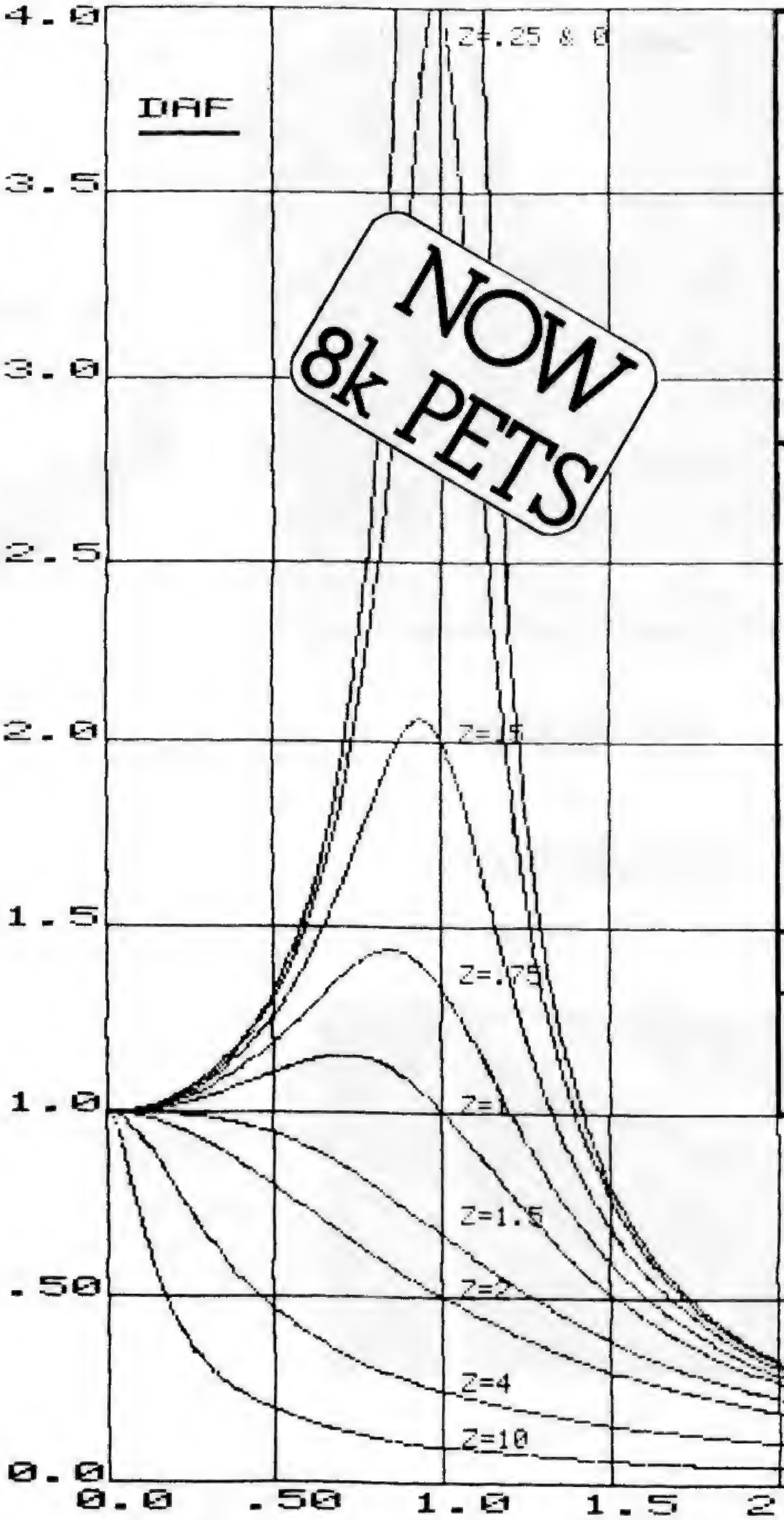
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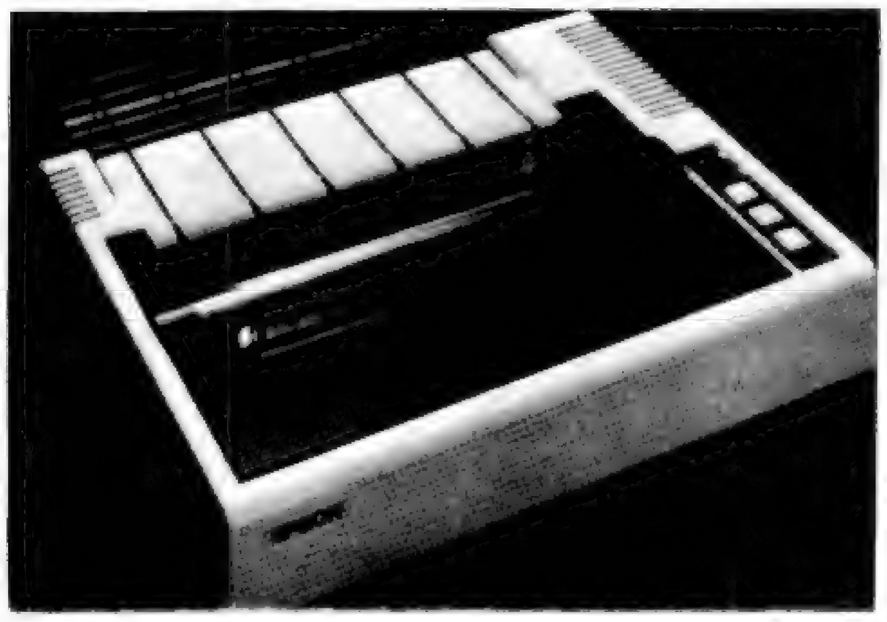
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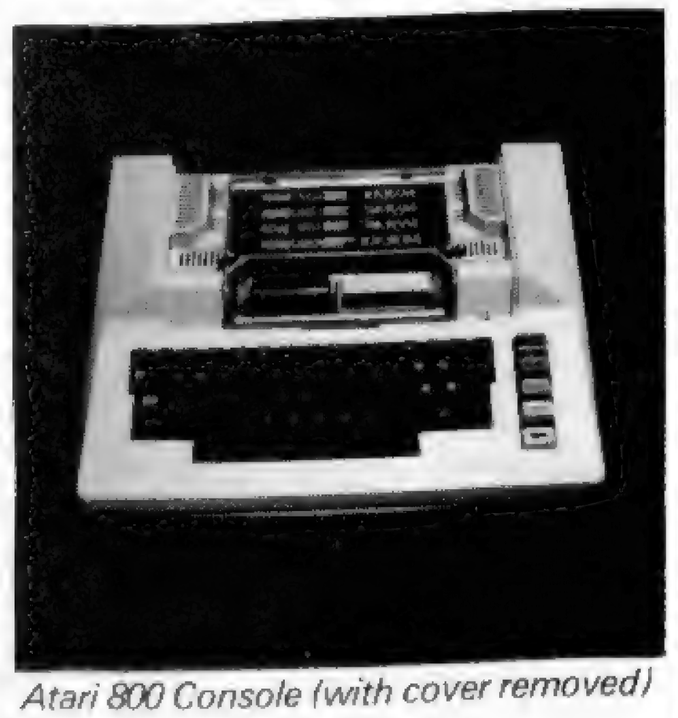
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From easy to dangerously difficult — you'll find it hard to resist the challenge time after time!

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No hardware modifications are necessary to get moving graphics. Just follow the instructions for cassette loading and off you go; no extra memory needed, uses the 4K ROM.

● **MACHINE LANGUAGE**

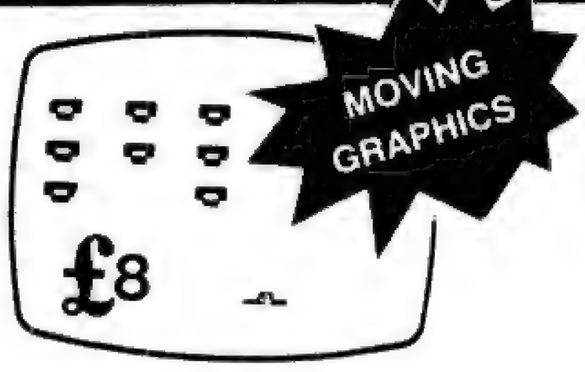
These programs are written in the computer's own language — only this way is it possible for continuous, flicker free action to occur.

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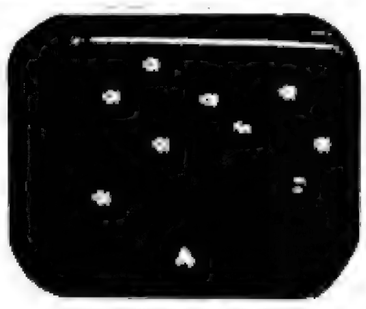
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COSMIC FIGHTER WITH SOUND



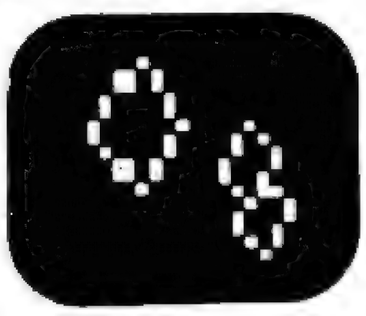
Your fighter appears Below a convoy of aliens! If you destroy them another set appears who seem to be slightly cleverer than before! Soon your space station nears but before you can dock the station comes under attack! Survival is up to you! The excitement is just beginning!!

TRS80 Levels I & II 16K Tape	£10
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Video Genie

NEW

ASTEROID NOVA

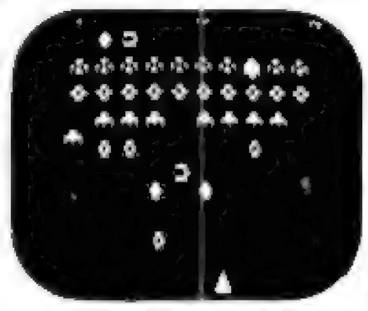


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ZX80

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UNIX 7 operating systems

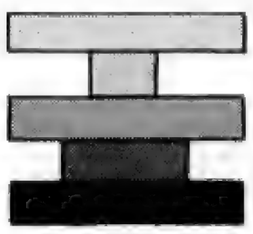


BASIC, COBOL, FORTRAN,
UCSD PASCAL, MUMPS, C

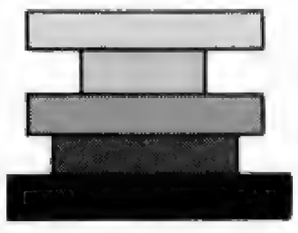


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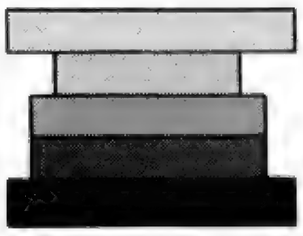
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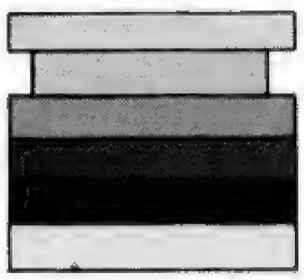
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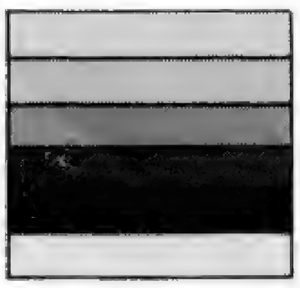
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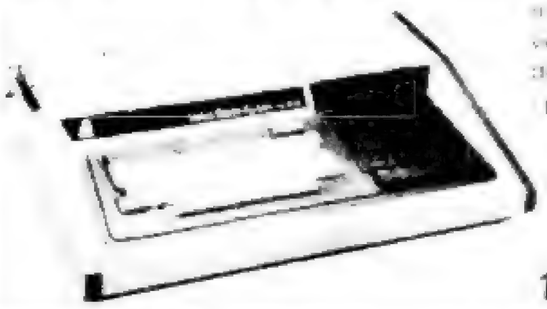
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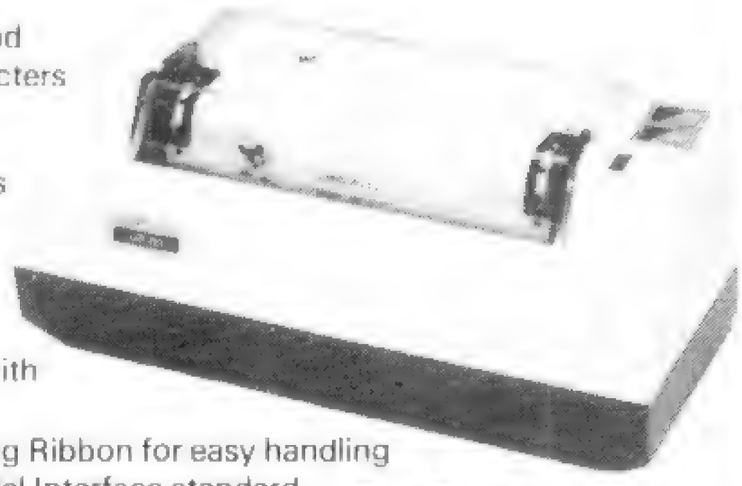


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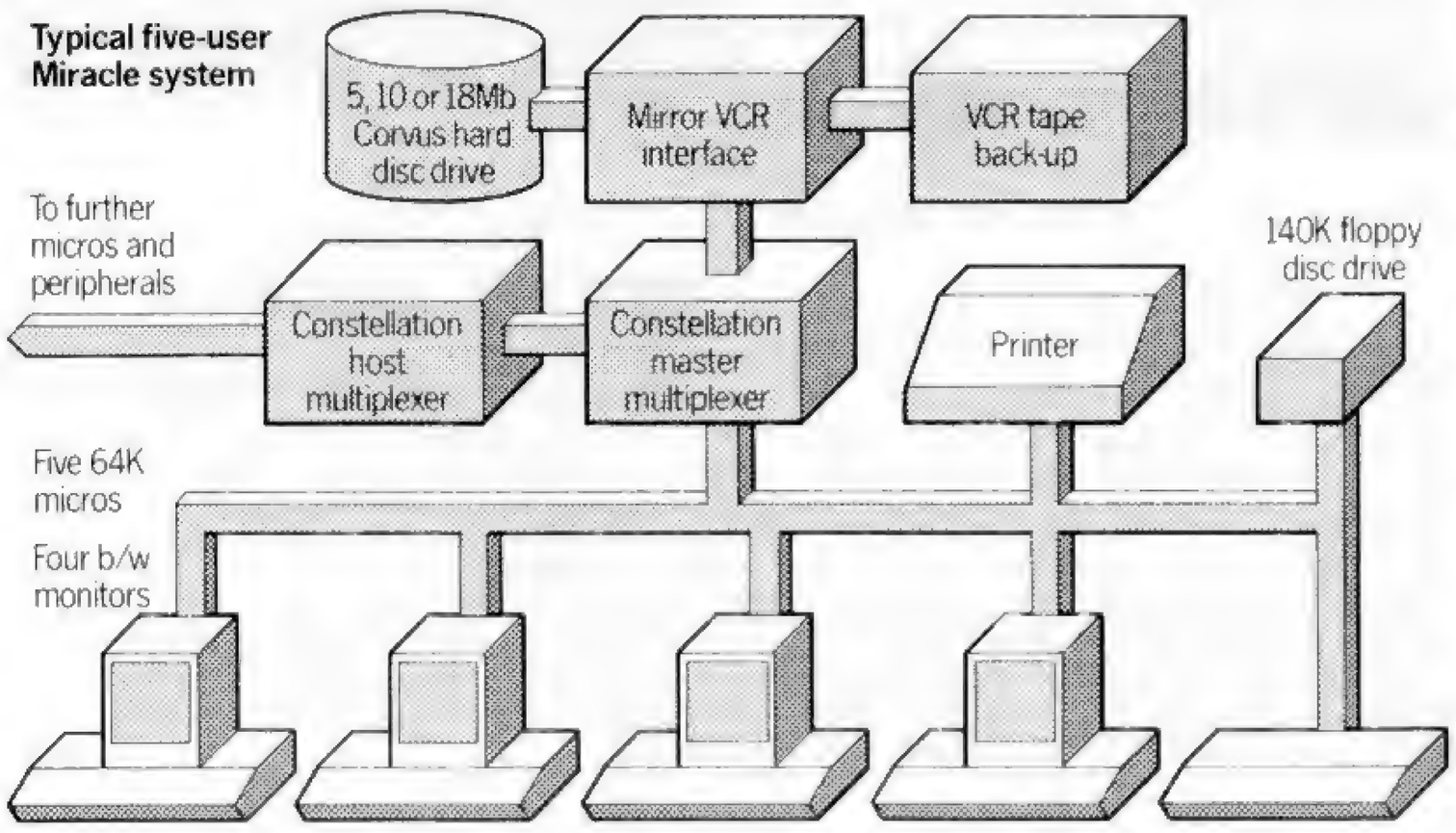
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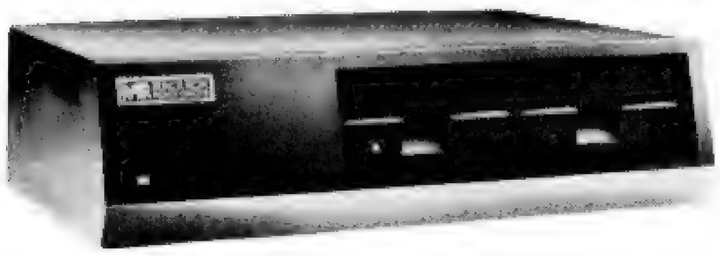
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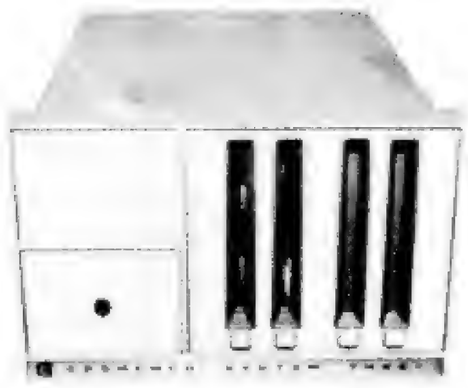
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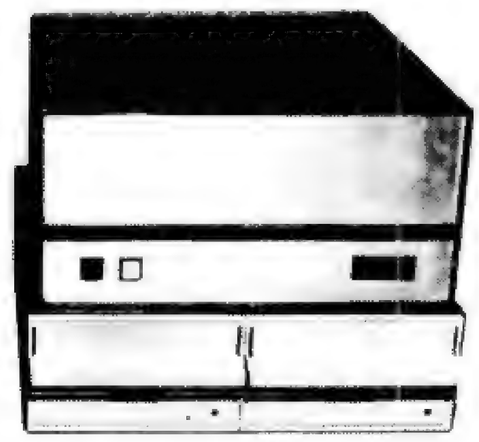
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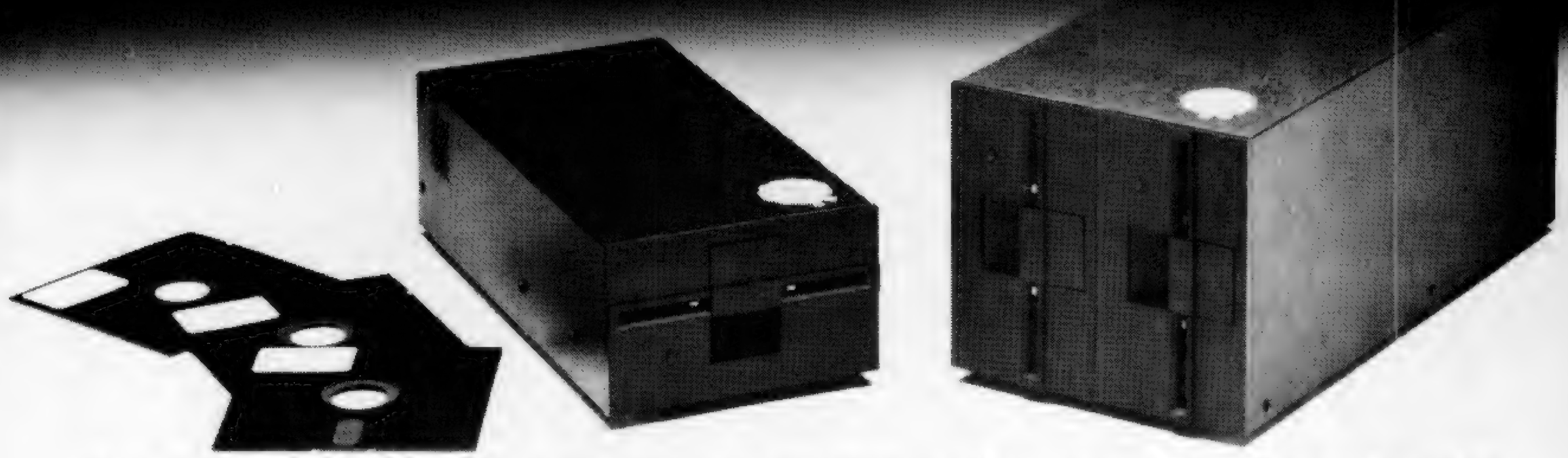
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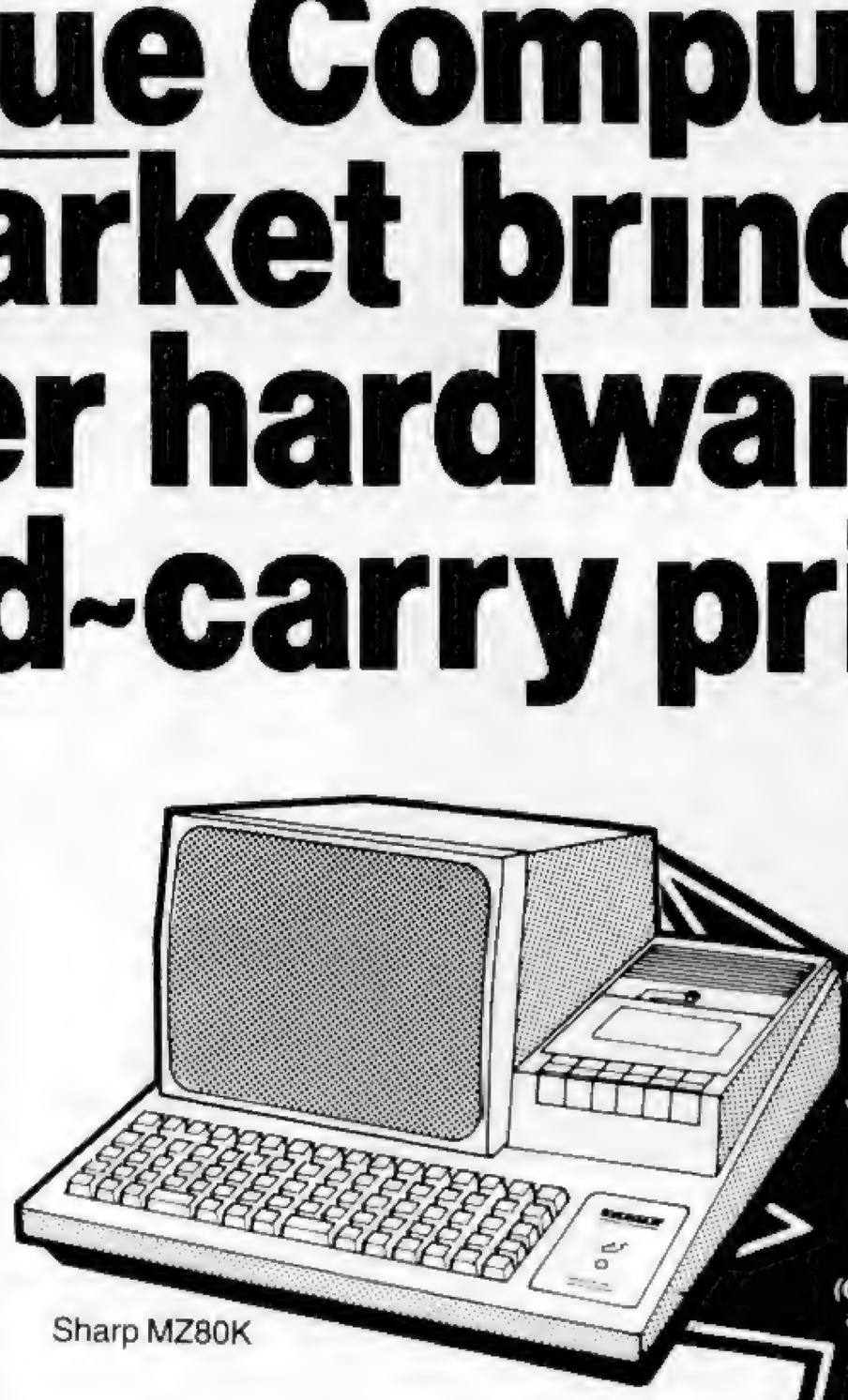
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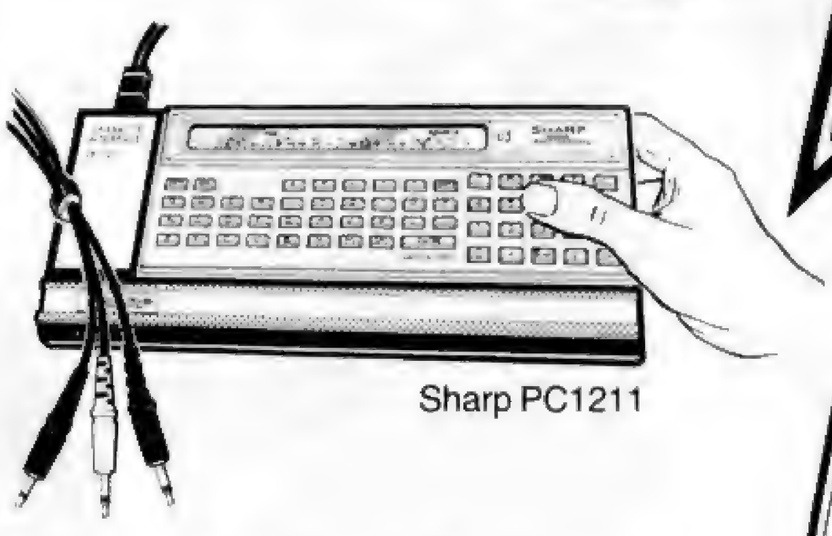
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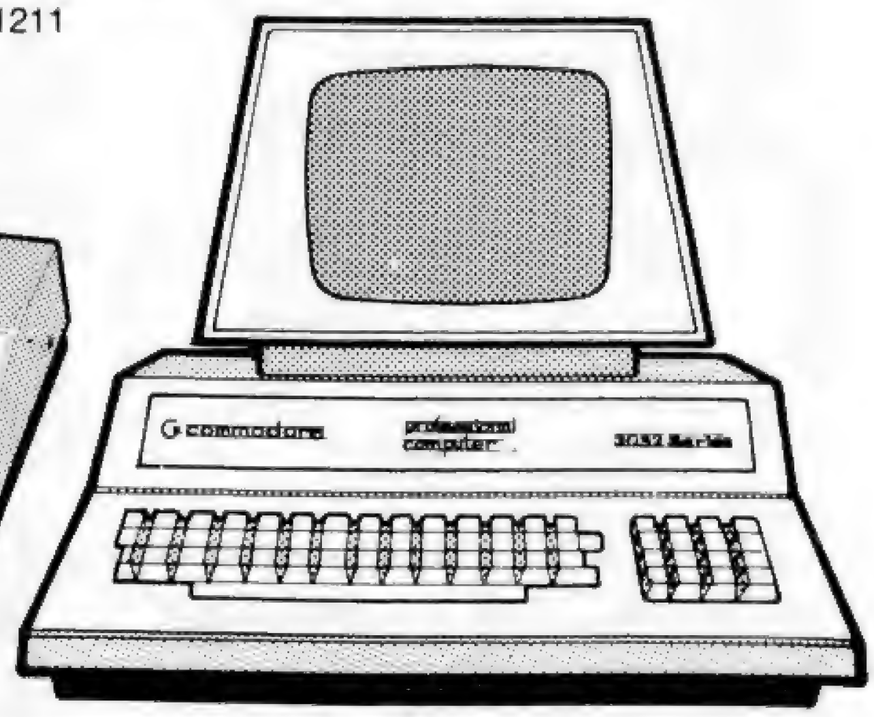
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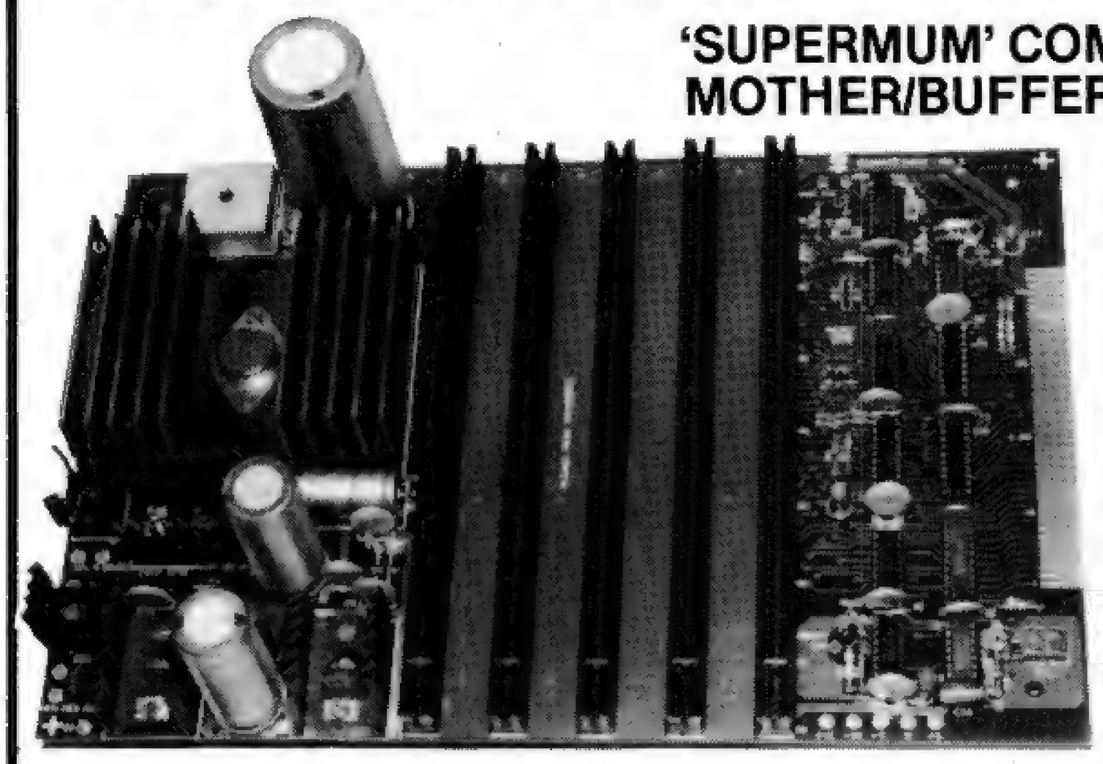
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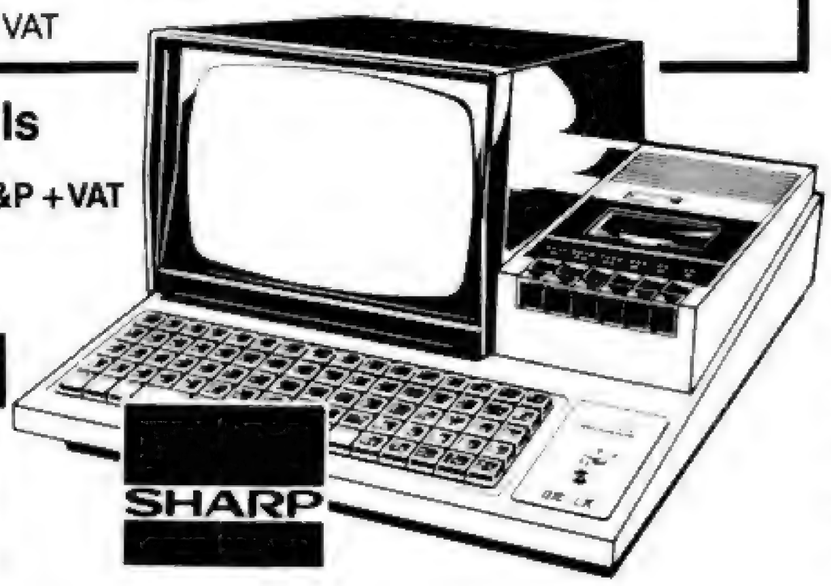


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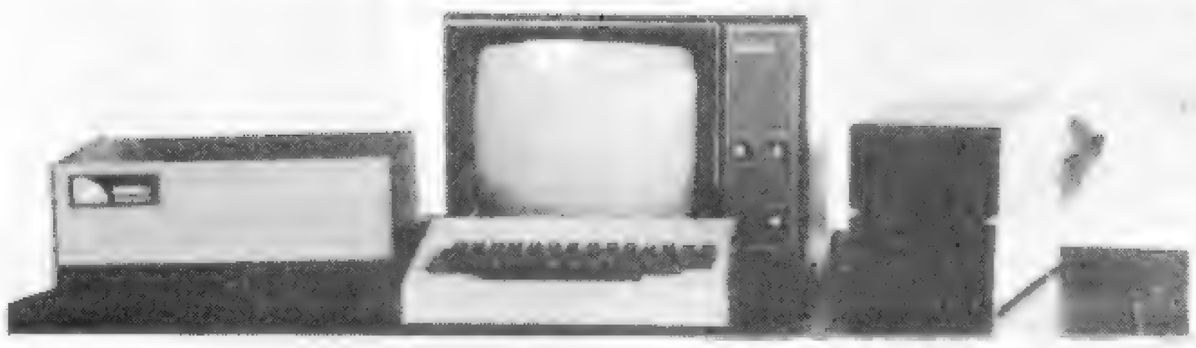
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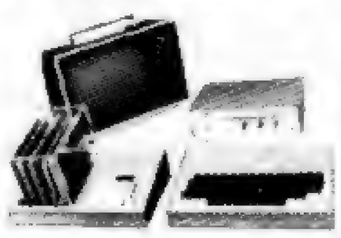
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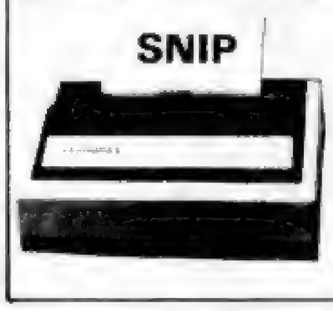
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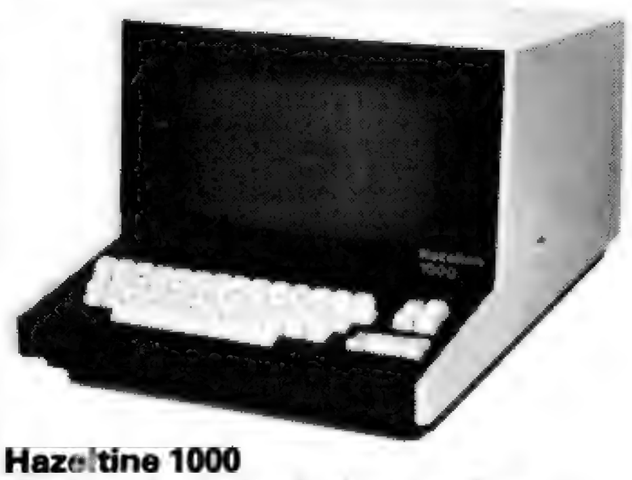
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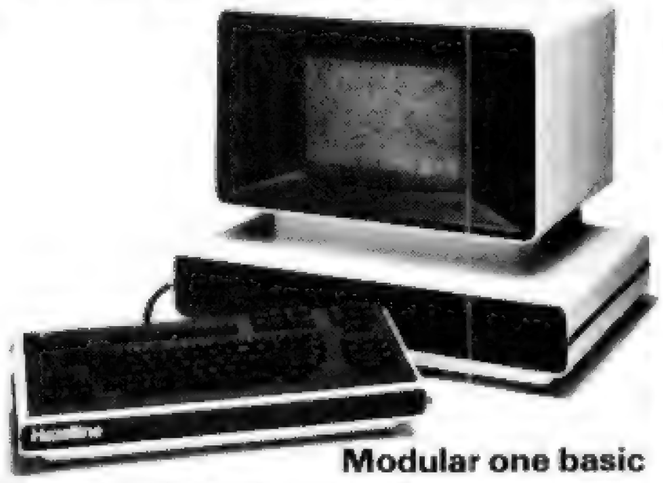
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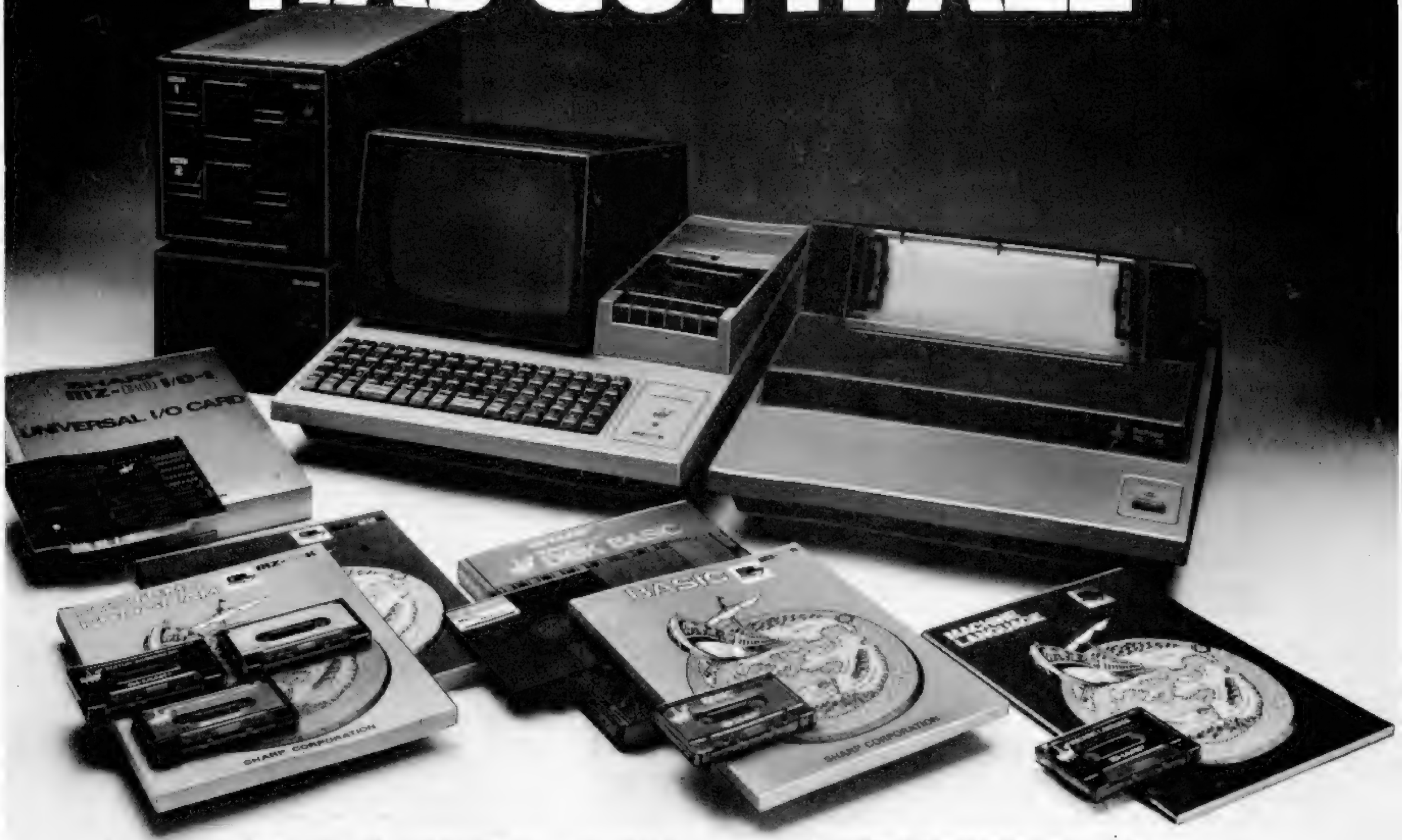
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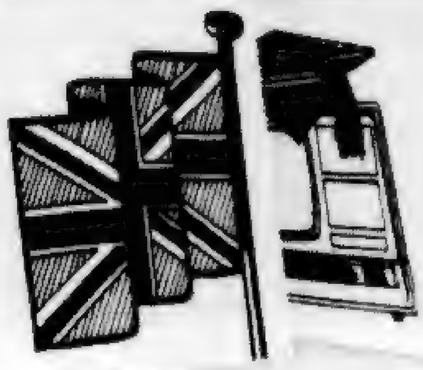
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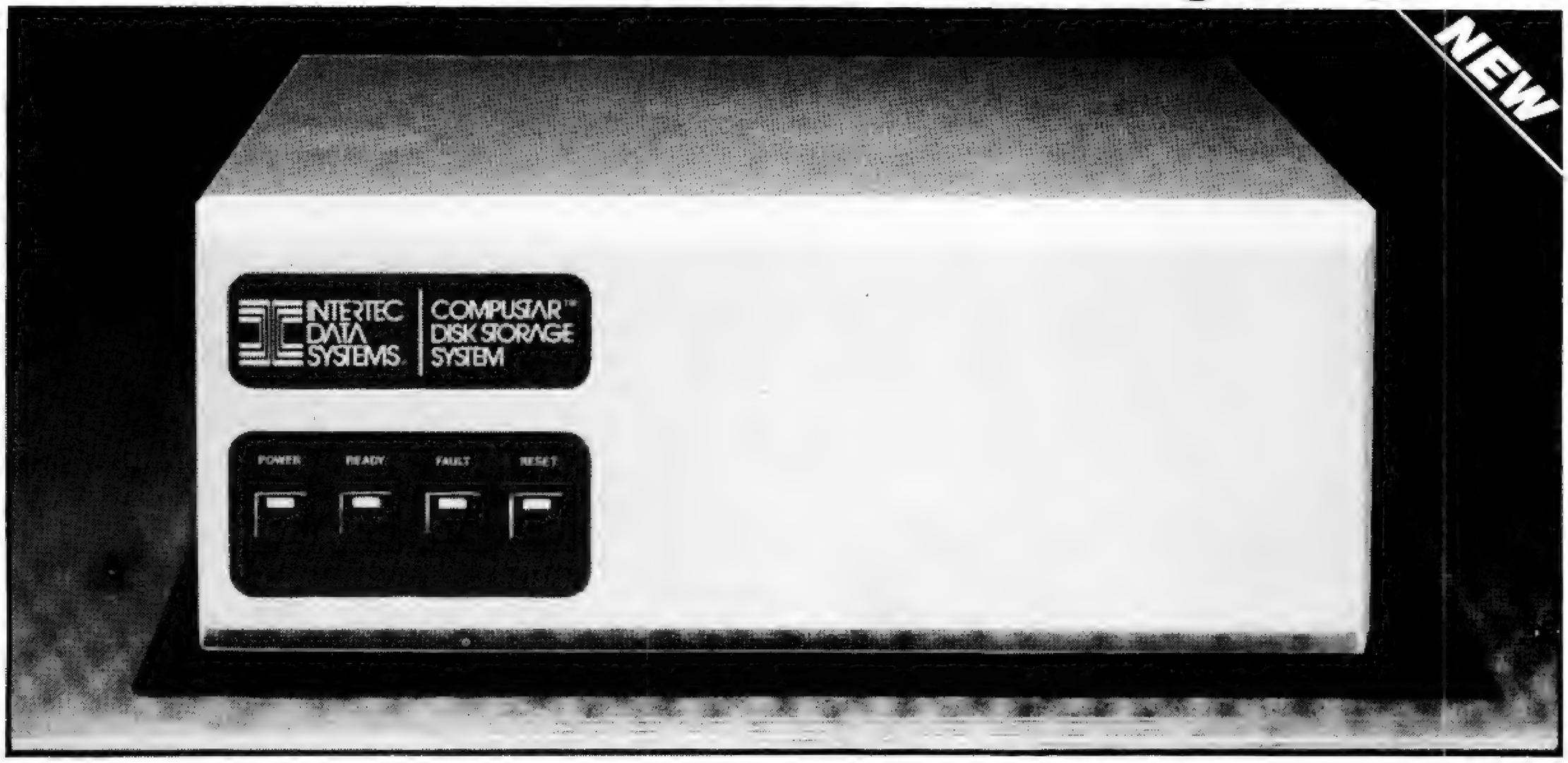
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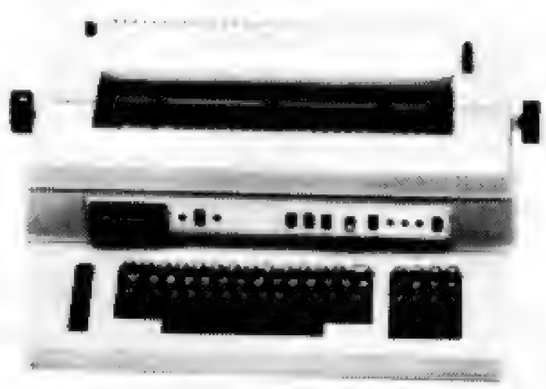
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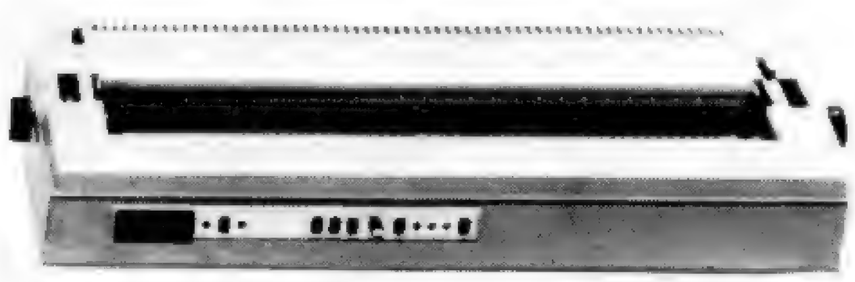
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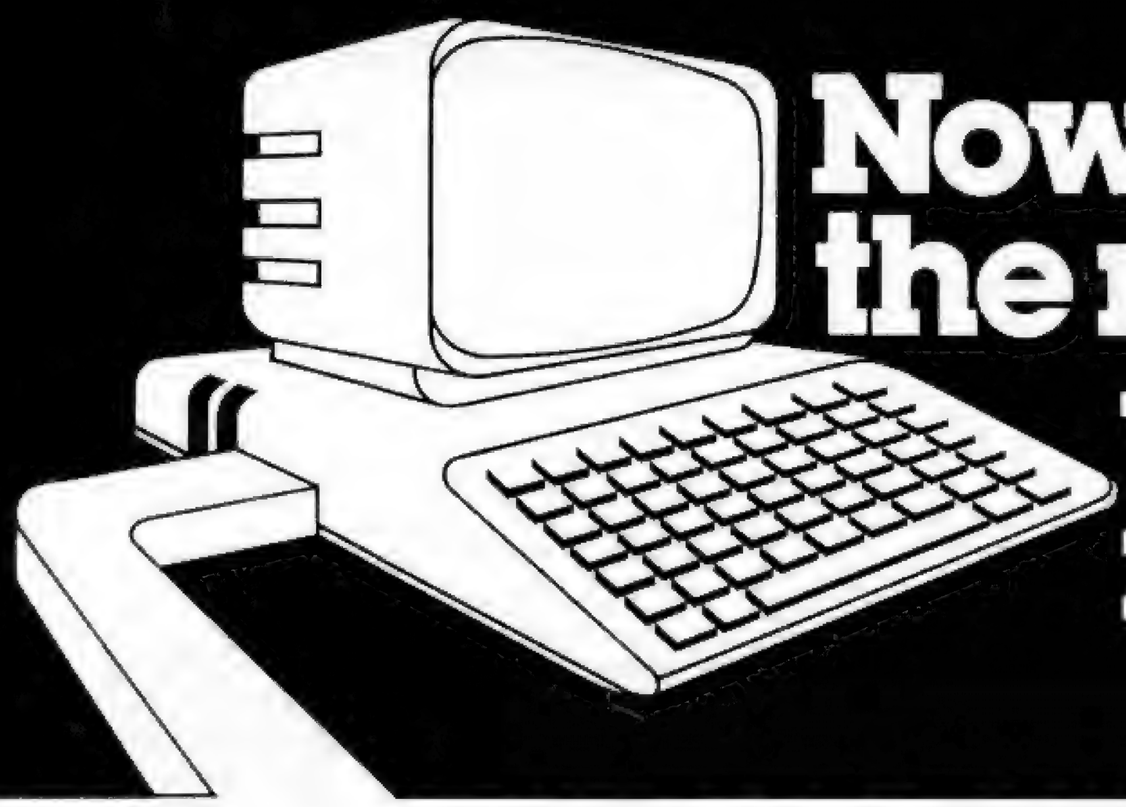
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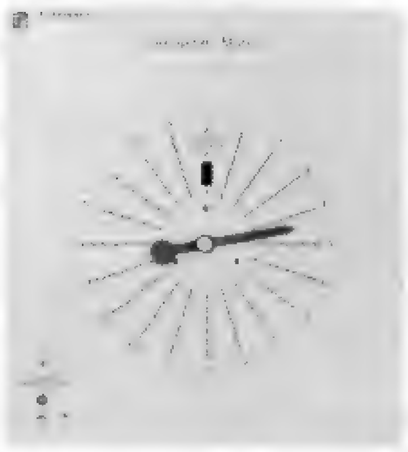
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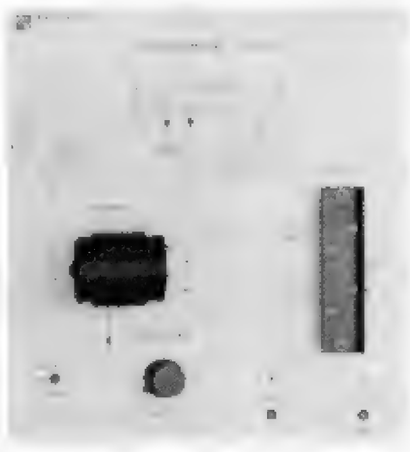
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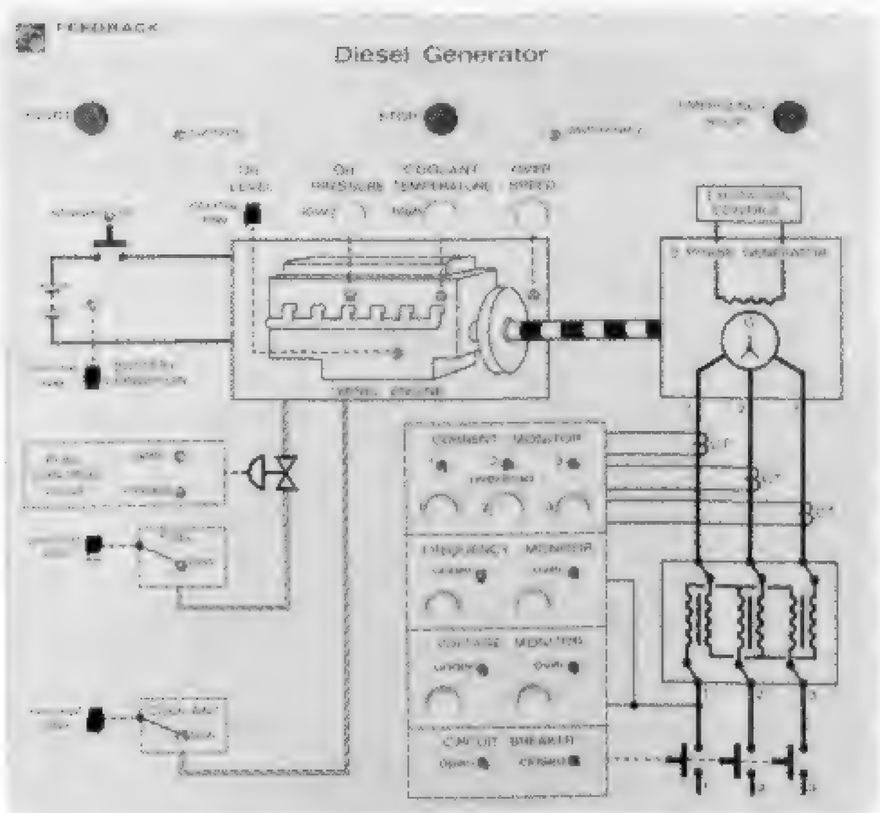
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NEWSPRINT

Guy Kewney, editor of Datalink, *presents the latest micro news.*

Lucas buys Nascom

At last, the Nascom future is assured. It was once Britain's proudest microcomputer company; in the year it has spent waiting for a buyer, it has got at least a year behind the times and its new owner Lucas Logic can't be expected to catch up very quickly. So when the new General Manager John Deane says, 'I believe Nascom's incorporation in our computer portfolio cements Lucas Logic's position at the forefront of this sector of the computer business,' it isn't altogether clear which sector he's talking about.

For the computer users, the takeover means that supplies will continue to flow from the new headquarters in Warwick — until they lose interest in Nascom and want something better. After that, the signs are that Nascom will think hard before investing in a new design aimed primarily at the competitive £200 system market. Instead, the company obviously sees Nascom machines as useful in industrial and commercial applications. It will probably be daunted by the problems of designing something to match up with the Osborne 1 or even the Shelton Sig-Net or the Gemini from John Marshall (the guy who started Nascom in the first place) when they are all available and working in the UK. The reason for being pessimistic is that there is no such things as an established microcomputer company. The market is changing so fast, the technology is moving from one company to another and software is evolving; all these things mean that each year a micro company survives are essentially years of innovation. Big, established companies (like Lucas) aren't good at that.

Blowing Bubbles

The waiting may be over for a really useful bubble memory system, one which can be plugged into a system like a games cartridge but which can have its contents changed, like a floppy disk. Intel, the chip-making company which first experimented with bubbles, has at last announced a product.

It's expensive because it's still tricky to make bubbles. They are, as specialists will know, microscopic magnetic circles, areas of magnetism which show up looking like bubbles on microscope photographs, and the magnetised areas can be moved from one point to the next in a chain of magnetisable molecules. Seen from above the garnet chip surface, as a magnetic field rotates around the chip, a long procession of bubbles marches in orderly single file and, of course, emerge from the other end in the same sequence they went in. It's a bit like watching the magnetic pulses pass the 'read' head of a disk drive, as the disk spins under it and, not surprisingly, it can be used the same way.

Normally, these bubble chips are sold in their little magnetically sealed packages, with their own circuitry to rotate the field inside the package and store the data in an endless loop.

What Intel has done is to advance the packaging a bit. Several bubble boxes and some control circuitry are put into a little cartridge about the size of a fat paperback, which can be plugged into a control box about the size of a small floppy disk drive. The idea is that a system with a disk drive already fitted can have this drive plugged in instead. At a price of $2550 for the 'drive' and one cartridge, plus the odd bit of extra interface circuitry and boxing adding up to another $1000 or so, it doesn't compare with a disk drive — especially as the cartridges cost $1915 all on their own (compared with £5 or less for a disk).

And its capacity may be 128 kbytes — about the same as a disk — but it operates at disk speeds, that is, slowly, unlike the games cartridges which have read-only-memory chips and therefore function as fast as the computer's own ROM.

Intel is well aware of these drawbacks, hence its emphasis on a promise that prices will definitely come down. By the third quarter of this year, the price will drop by 26 percent says Intel, and a year later will have dropped by a further 35 percent. However, these are prices to dealers and you have to buy 100 at a time to get them.

In other words, feel free to buy a system using ROM cartridges, or using disk, without any fear of having it go obsolete on you inside five years.

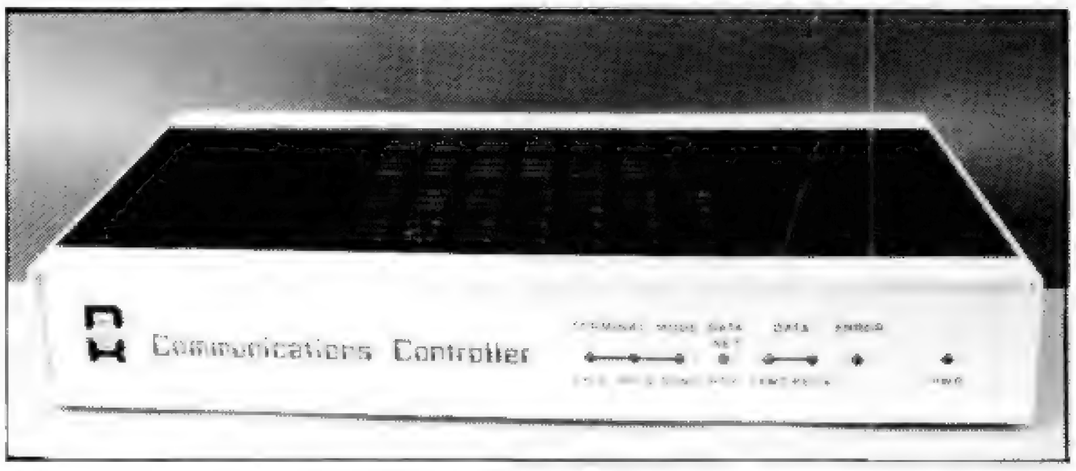
Pricey model

Nobody thought of doing Visicalc until it appeared; then, suddenly, everybody was producing things that 'do the same modelling job as Visicalc but better.' One of these which was supposedly better is Micromodeller and it has at least outsold Visicalc, in revenue terms, in the UK, so it must work. But since it costs six times as much, it's worth reporting that the new version of Micromodeller which is available for the SuperBrain micro should be seriously compared with the original, Visicalc.

The supplier, Intelligence (UK) Ltd, claims that Micromodeller has 'proved to be just what the micro industry was looking for to persuade senior managers to use personal computers.' The SuperBrain version is the first of several that will run on machines using CP/M as their operating system, says the company. Details on 01-947 9846 from Michael Healy or Ashley Ward.

Exclusive set

Tim Keen must be virtually helpless with laughter as he watches his fellow 'sole distributors' of the Onyx 16-bit microsystem perform an elegant ballet exactly along the lines of the one he



The Commodore PET, like many similar microsystems, is clever enough to pretend to be pretty dumb. And one particularly dumb thing it can do is pretend to be a terminal connected to an orthodox large computer in an air-conditioned room and pretend well enough to fool the large computer.

Latest of several products to carry out this deception is from Davidson-Richards, a company which has produced a little box of electronics to allow the electrical connection to be made, either through your own wire or through a modem and a bit of British Telecom wire.

The system is available to support ICL's CO1 and CO2 protocols and to emulate the performance of ICL equipment with the following model numbers: 7181, 7501, 7502 — and IBM workstations model 3780 and 3270.

Interface box plus software for the PET costs just under £1000; with a working, disk-based PET and printer, a complete work station is around £3000. Details on Derby (0332) 366803.

got involved in around November last year.

And well he might. They are now (count them) five 'exclusive' distributors of the Onyx system.

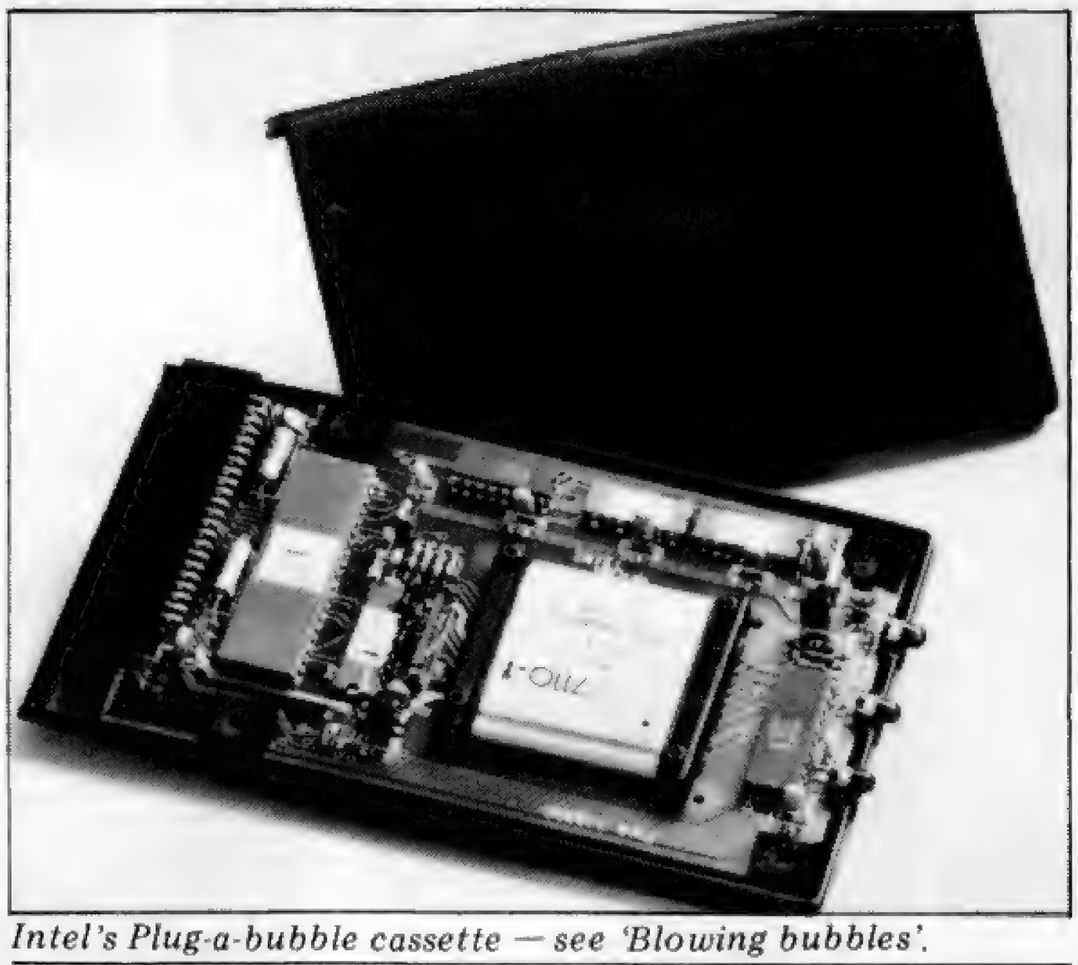
Oh, I suppose it isn't kind to laugh too loud and I'm sure a reasonable 'solution' has been found by now but it really was fun. First, Paul Joyce of Graham Dorian (or is it of Terodec — or both?) was told by Doug Broyles, Onyx president that he was the exclusive UK importer. That was at Compec, when Tim Keen's company, Keen computers, also had Onyx systems for sale on its stand. The somewhat acrimonious debate which followed ended when it was decided that Keen got his through Corvus, an associated company and Paul Joyce got his direct from Onyx. So both were exclusive.

After that, the humour of the business faded and the machine went through a somewhat thin time. There-were, in short, problems. As recently as mid-April, one of the dealers (I ain't saying which) could be heard confessing that they weren't selling well. Some say that the problems centred on defects in the power supply, which caused the data storage device, hard disk, to fail in unpredictable ways. Certainly the diagnosis of what was wrong was hard to make and I've heard many different theories — quite usual when a power supply problem is at the root of things, since it can cause a wide variety of symptoms. Then things started picking up; systems started selling in more than ones and twos.

At that point Doug Broyles sent his marketing colleage Steve Gant over to this country. Gant arrived with a couple of pieces of paper, apparently signed in advance by Broyles, with blank spaces naming exclusive distributors.

Gant, who had previously poured some scorn on the claims of Paul Joyce (he said, 'some people have been going around saying that they are pan-Galactic agents for all of Europe') gave the pieces of paper to two new firms, Scan Data and Thame. Thame used to be called Memec and sold Zilog equipment. Scan Data had other interests and a PR agency with some style — the agency announced that 'joint exclusive' distribution rights (whatever that means) had been awarded to the two companies.

This announcement appeared on a press release with Onyx's San Jose address and phone number. It included the somewhat odd suggestion that the appointment 'must inevitably give rise to some speculation over the future of other companies who had franchises.' The release struck Paul Joyce as odd, too.



Intel's Plug-a-bubble cassette — see 'Blowing bubbles'.

Not because of the strange sight of Onyx apparently speculating over its own actions but because he had just been preparing a press release of his own, announcing that Onyx Distribution Inc and Onyx Distribution Ltd had been set up to handle the pan-Galactic marketing of the Onyx. Paul himself, he had been told by Onyx, was to be head of the UK branch of this. So he bought himself a ticket for San Jose. There' an agreement was being formulated at press time, along the lines of 'Paul Joyce of Onyx Distribution is the UK distributor and the others are also purchasers of the original equipment and Doug Broyles didn't know about what Steve Gant was doing but Gant is entitled to appoint agents and they will get their staff (officially) through Joyce.' It'll 'save face' or something.

The real puzzle isn't 'who is the exclusive distributor?' but, rather, 'who would want to have it known that they were the only source?' Somehow the myth persists than an importing and service firm can wear the word 'exclusive' like some kind of badge, conferring instant international importance. The fact that many customers are probably nervous about dealing with an 'exclusive' distributor, with no backup if it goes under, seems to be of little importance compared with the need to boost the managing director's ego.

Cheap or costly

Just how one measures 'user satisfaction per £' is something the UK micro user will have to evaluate carefully. On the face of it, this new commodity either comes pretty pricey, or you can get an awful lot of it wrapped up in a new British-built micosystem, costing just under £3000.

For the money, LSI Computers will sell you the M Three and the machine is not heavily overpriced, providing you share its makers' pleasure in the display, the keyboard, and the inclusion of two double-density disk drives.

The company is aiming for buyers with slightly more 'office equipment style' tastes than buyers of something like the SuperBrain but with a keener eye for a bargain than buyers of. . . Well, anything offering two disks, processor and screen for around £4000 upwards (and there are several).

The question isn't really how well it compares with SuperBrain, however, but how it will compare with the Osborne 1 if and when that arrives in this country at under £1000 with a rather better software performance.

The M Three keyboard has 109 keys, which is a lot and, properly programmed, they could be very helpful. The display offers 1920 characters (80 characters on 24 lines), which is better than many micros give you and better than Osborne gives now but fewer than Osborne gives if you count the 'invisible' characters to left, right, above and below the 'window'.

And it doesn't have all Osborne's free software, though it does include CP/M as the operating system.

If LSI Computers had launched this machine in February, it would have made quite a splash. After the Osborne announcement, however, it's hard to grasp the tone of self-satisfaction with which it confesses that it had £1 million worth of DoI money, followed by the claim that 'specification and price have been carefully geared to researched market needs.' When was the research done?

Details on 01-836 2205, which is LSI's publicity agency number.

Quick quote

To quote Steve Jobs of Apple in a comment now much repeated in Silicon Valley where the chips come from: 'We designed Apple II with six guys and it's about to become the most-installed computer of all time. We designed the Apple III with a corporation of 1600 and it still doesn't work.'

ADA

Any computing machine using the 6502 micro, such as Apple, Acorn and PET and with an 8-bit parallel port, can be connected to electronic experiments, processes, automatic test equipment, home environment 'or whatever' through a new interface from Contrology.

It's described by its maker as 'low cost', a claim which they infuriatingly fail to back up with figures (always a bad sign) but it does fit in a crate, so don't count on spending less than £100.



LSI's M3 — see 'Cheap or costly?'

nascom

.... Computing for everyone

Nascom products, designed and built in Britain, are now backed by Lucas one of Britain's foremost industrial companies. This is a vindication of the innovative design of the Nascom computer and an assurance of its future.

NASCOM-1

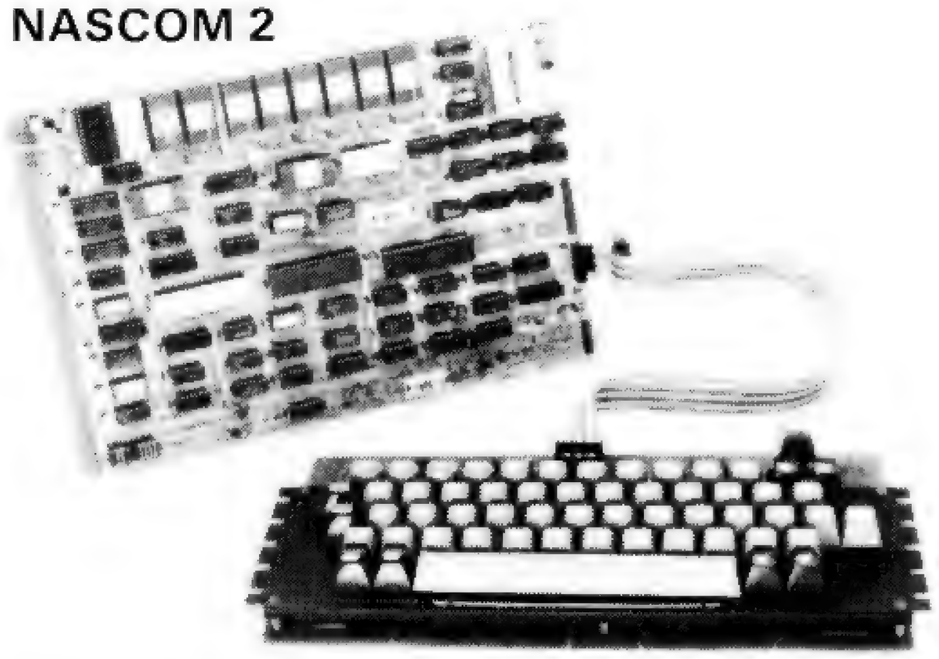
Kit Price **£125** + VAT

Built Price **£140** + VAT



12" x 8" PCB carrying 5L SI MOS packages. 16 1K MOS memory packages and 33 TTL packages. There is on board interface for UHF or unmodulated video and cassette or teletype. The 4K memory block is assigned to the operating system, video display and EPROM option socket, leaving a 1K user RAM complete with keyboard.

NASCOM 2



Kit includes all parts to build CPU board which has resident 8K microsoft BASIC and 2K NAS-SYS 1 monitor for machine code programming. Included with kit is a fully assembled LICON QWERTY SOLID STATE KEYBOARD specially designed to exploit the potential of the NAS-SYS monitor. Other interfaces include video to monitor or domestic TV, Kansas City standard cassette interface (300/1200 baud) or RS232/20mA teletype interface.
In addition to full character generator graphics ROM is provided to give BASIC on board graphics capability.
System uses Z80A which gives selectability between 2 or 4 MHz.

Nascom 2 Kit Price **£225** + VAT

Power supply—3 amp. Suitable for powering of basic Nascom 1 or 2 and memory expansion.

£32.50 + VAT

RAMBOARD

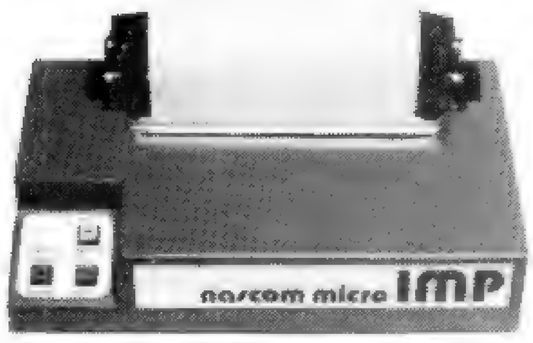
SERIES B ramboard gives user option of 16K DYNAMIC RAM. This board can be arranged in page mode to allow use of up to 4 with NASCOM 2. Boards are fully buffered but PAGE MODE facility is an optional extra. This card can be used at 4MHz without wait state.

16K **£120** + VAT

Lucas Logic

Nascom Microcomputers
Division of Lucas Logic Limited
Welton Road Wedgnock Industrial Estate Warwick CV34 5PZ
Tel: 0926 497733 Telex: 312333

NASCOM IMP PLAIN PAPER PRINTER



The Nascom IMP (Impact Matrix Printer) features
● 60 lines per minute ● 80 characters per line ● Bi-directional printing ● 10 line print buffer ● Automatic CR/LF ● 96 characters ASCII set (includes upper/lower case, $, £) ● Accepts 8½" paper (pressure feed) ● Accepts 9½" paper (tractor feed) ● Tractor/pressure feed ● Baud rate from 110 to 9600 ● External signal for optional synchronisation of baud rate ● Serial RS232 interface.

£325 + VAT

NASCOM FIRMWARE

CPU card can accommodate either 8K of static memory or 8 2708 EPROMS. This allows for inclusion of standard firmware on board.
ASSEMBLER Version 2.0 of ZEAP (Z80 Editor Assembler Package) offers in 4K features found normally only in far larger programs
A comprehensive line editor is provided in addition to an assembler operating in standard Z80 mnemonics. Direct assembly to memory allows immediate program execution. ZEAP can take advantage of special features of NAS-SYS, which was itself developed on this assembler Supplied on tape at **£30.00** plus VAT or in 4 x 2708 EPROMs at **£50.00** plus VAT.
DISASSEMBLER The NAS-DIS 3K disassembler reverses the effect of assemblers such as ZEAP by turning machine code into assembler program, automatically labelling and cross-referencing to produce a complete program listing, saving hours of tedious hand disassembly when program analysis is required. Supplied in 3 x 2708 EPROMs at **£37.50** plus VAT.
DIAGNOSTIC PACKAGE NAS-DEBUG is a 1K addition to NAS-DIS which provides remarkable facilities for error elimination, including a full register display which may be edited by the cursor. An unusual feature is the provision for examination of the program *in assembler* as the machine single-steps through it. A second video page may be assigned to allow work on programs which use the screen. A very powerful assembler-based system for program development could be realised on a NASCOM-2 with appropriate external memory by fitting the 8 ROMs containing ZEAP, NAS-DIS and NAS-DEBUG into the sockets on the computer board. This system would function immediately on switching on, without needing programs to be loaded from tape. Supplied in a 2708 EPROM at **£15.00** plus VAT and must be operated with NAS-DIS

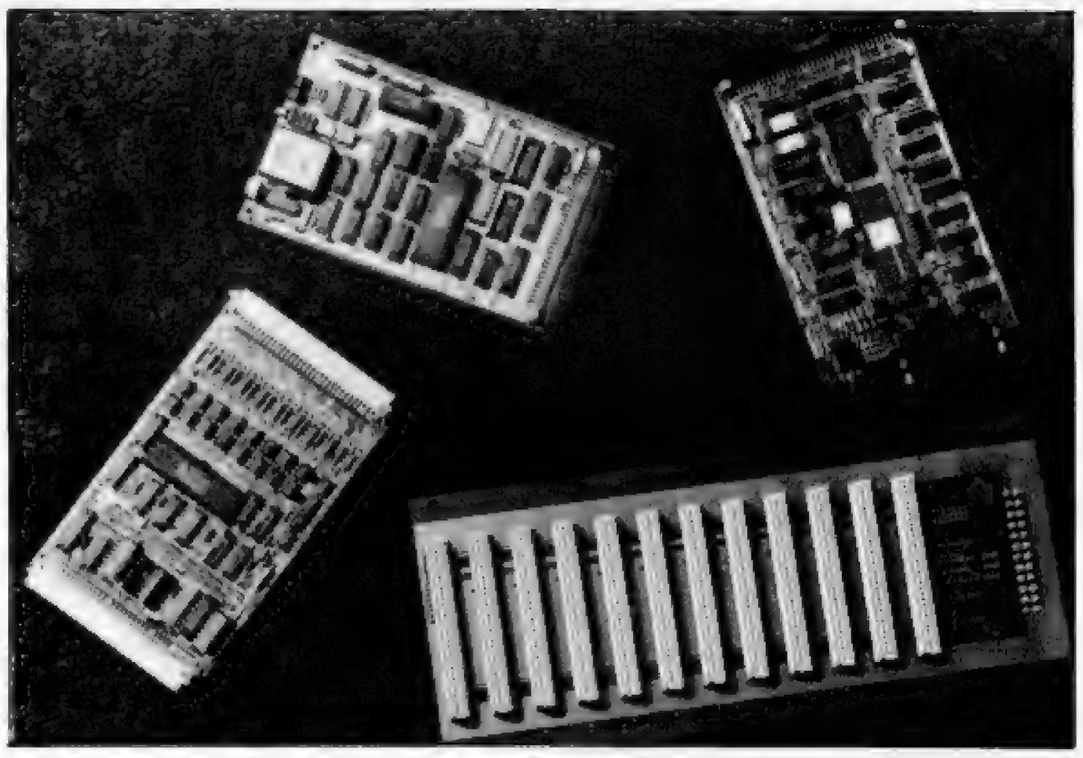
NAS-SYS 3. THE NEW OPERATING SYSTEM FOR NASCOM 2.
Supplied in 1 x 2716 EPROM
NAS-SYS 3 is the latest in the current series of Nascom monitors and includes features such as adjustable keyboard repeat and cursor speed, full interrupt handling and a number of powerful routines and commands making this probably the most comprehensive 2K monitor ever written for a microcomputer. **£40.00** plus VAT.

TO BE INTRODUCED

	Price
Programmable graphics colour board	TBA
Twin floppy disk unit, double sided, double density with NASDOS or CPM 2.2	TBA

WATCH IT!!
Nascom products fully assembled and packaged in the near future!

Please send SAE for list of distributors.



Probably you've admired the amount of aluminium girder and sheet metal inside most multi-board microsystems, necessary to hold each board in steady contact with the 100-pin sockets under it. The less girder, the cheaper; the Eurocard frame should work out cheaper on that basis. Actually, it doesn't because it uses much better contacts; this set of boards is to the new Eurocard DIN 41494 specification, and allows you to build a system using Texas Instruments' 990 microsystem. It's from BA Electronics in Bristol: details on 0454 315824.

The Base unit is a Eurocard box taking up to four add-on cards. These can be either the 6151 unit, which drives relays capable of switching 5 A of mains voltage (eight of them) or the analogue-to-digital and back converter card, the 6152. Details in East Kilbride from W I Macfarlane on 035 52 77153.

Find your roots

The nicest thing about family trees, I've always thought, was the beautifully-scribed caligraphy with all the names in their right place, linked by lines showing blood relations. Nothing, however, could be more frustrating than drawing one of these and then finding that it wasn't quite right. A program to get it all right, to calculate which way the third cousin four times removed links work and also to work out anniversaires, costs $125. It's called Roots, from Commsoft in Palo Alto, California CA94306; it runs on CP/M machines or on Heath Hdos. Phone (415) 493 2184.

Pascal party

Programmers who are proud of something they have written in the up-and-coming language Pascal can show off a bit in front of their peers. Apparently, a group of programmers who specialise in using the version of Pascal from the University of California at San Diego (UCSD) got together and had a great time in Bristol at the end of January. They just couldn't wait to get together again, so they have arranged a second meeting, in London, on 11-12 September.

Users of UCSD Pascal who plan to present a paper to the next meeting should send an abstract to the organiser, Cornelia Boldyreff. She's apparently most keen to have people talk about the use of Pascal and the p-system in a commercial application. And if you have a commercial product of your own, hardware or software, they would like to see it demonstrated at the meeting. Details from Maclolm Harper, secretary of the group, at Oxford University Computing Laboratory. The address is at the Programming Research Group, 45 Banbury Road, Oxford OX2 6PE. Abstracts to Cornelia at the Micro Software Unit of the SWURCC, University of Bath, BA2 7AY.

All together now

Last year I met my first big multi-micro system: between two and 100 users all working on the same information but all having a micro to themselves. A company called Jarogate in London (West Norwood) has now appeared with a new multi-user system.

Jarogate is following the lead set by Digital Research, the American software house which has led us from CP/M (four users, but not at the same time) to MP/M (two or more users, cursing each other up and down for fouling up the system) and finally CP/Net and its niece or nephew, CP/NOS.

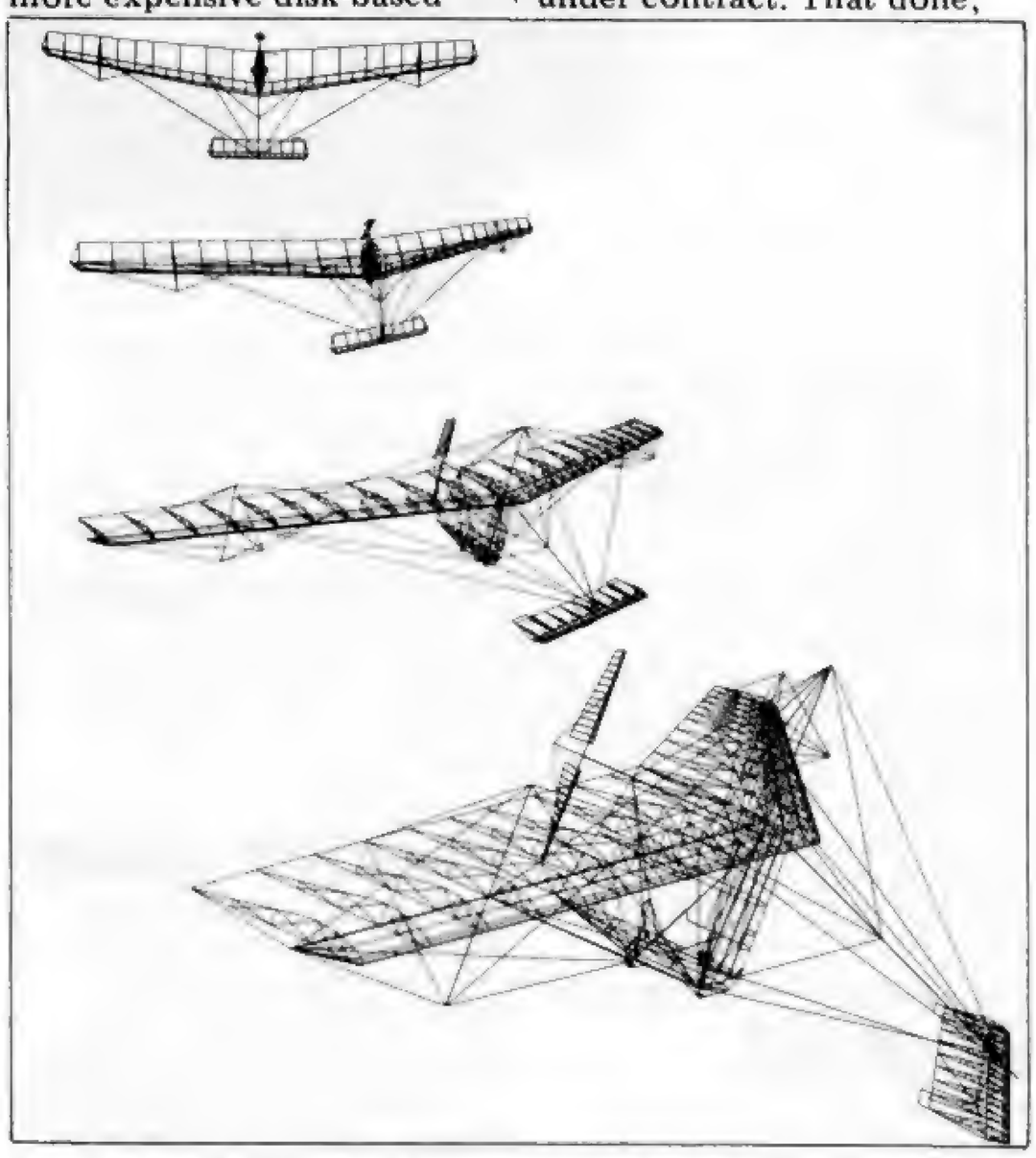
The Jarogate system looks like a standard Cromemco system with a modern high-capacity hard disk storage system, with an extra box the same size on top to contain from four to seven extra processor/memory boards. At £10,000 it should be able to satisfy those people who really do want to have four to seven people doing much the same sort of things on much the same sort of data simultaneously and who really don't just want four to seven separate computers. Jarogate is on 01-670 3674.

Micro market

Figures on just how big the UK micro market is, may be and will one day become, are hard to find; a £25 good guess is available from Keynote Publications. It describes the area it covers as one 'which has been little affected by the recession,' which must be the understatement of the year. It surveys 11 manufacturers over three years, showing the difference between booming turnover and narrow profits, and suggests that 115,000 will be installed in the UK by the end of the year. I would have put that figure on the number sold at the beginning of the year but maybe Keynote is talking about the more expensive disk-based system? Still, in a business where guesses are usually the best you can hope for, these figures will be eagerly seized on by many (like Nascom's new owners, I dare say) who are blundering around in the fog. Get it from 23 City Road, London EC1Y 1AA.

Insure your micro

Nobody on this paper would pretend to know a good insurance policy from a bad one but since Stewart Wrightson broking group has bothered to put together a special package for computer users providing cover for people with systems costing less than £5000 (another policy covers machinery worth more than £5000), it seems only polite to tell you about it. It is supposed to be marketed by the guy who sells you the system and he must provide (or arrange) a regular maintenance service under contract. That done,



Drawing pictures like this on a computer screen is a risky business for an amateur — it could easily end up with the screen burning itself out.

The pictures are a 3D plot of the man-powered aircraft (Gossamer Condor) which flew the English Channel, drawn and manipulated by a large and (relatively) expensive Hewlett-Packard HP1000 minicomputer by a large and (relatively) expensive Hewlett-Packard HP1000 minicomputer with a special screen. Keen-eyed readers will note that the lines are not plotted on a standard TV screen (where a regularly scanning line flickers into brilliance when it crosses a line in the picture) but are actually drawn directly, with the computer directing the electron beam. Now there is nothing to say that a clever experimenter could not stick some circuitry into a normal TV screen control to give him software direction of that beam — but could he give fail-safe control? Would he guarantee that if a software bug arose in the user's program, the beam would not jam in one position? Because if it did for more than a couple of seconds, the screen would explode from the excessive local heating. . . better stick to normal raster-screen graphics for the time being.



Any time you feel tempted to pour scorn on the idea that pocket computers will catch on, examine the Termipet and think again. On the face of it, it is a terminal to the PET which does nothing other than feed data into the computer without disturbing whoever is sitting at the main keyboard. And at £795, it costs more than some basic PETs by themselves.

The thing is, apparently, selling nonetheless, the reason being that it is battery operated and portable. It only has 23 keys, to allow it to collect numbers from a shop display area, or stock area, or whatever and it plugs into the PET later and sends the numbers into the machine. The software was developed for the Termipet maker, MSI, by PET dealer Mektronic. Details from MSI on 0628 33121.

it covers breakage and loss incurred by down-time and the cost of recovering lost data. Details on (0533) 21875.

Deaf aid

It turns out that you can see sounds just as well as you can hear them. A group of researchers in Cambridge have put together a video 'game' which replaces the normal process of listening to your own voice to see if the accent is going to please Mummy, with the analogous process of looking at the acoustic wave-form and matching the one from your spoken words with the one shown on the screen. It works, apparently, even if you're entirely deaf. The result is that deaf children, who usually end up speaking in a very rough approximation to the sounds made by those who can hear themselves, can adjust their voices to become perfectly intelligible.

Number game

You will have noticed that the PET started off with a number out of a science fiction film — 2001 — on its box and since then the numbers have been changing.

Actually, they have started having meanings. The 3032 had meaning in the last two digits (signifying the maximum internal memory) and the 8032 even gives you a clue as to the number of characters per line as well — 80.

So the 8096, which was expected to arrive at the PET Show, should have 96 kbytes of memory inside it . . . and it does. It needs it, say programmers, to be able to run new software such as Silicon Office. Silicon Office is (I quote from its producer, the inordinately modest Bristol Software Factory) 'undoubtedly the most exciting microcomputer program to be released this year.'

I suppose the 'exciting' bit is the collection of money from people who buy it. I found it more confusing than exciting from the description: 'it is designed to provide full electronic office facilities in one program'. It is an 'everything' program, in fact, handling word processing, communications over the phone network, accounting and stock control — you name it and it's there. So the program is very long. How well it works only a trial will tell. Details on 0272 314278. All I can say for sure is that it won't run on any smaller PET than the 8096, but it certainly sounds ambitious.

Mighty cassette

Memorial lectures are ostensibly designed to make sure we never forget the person whose name they are given. It doesn't take long, however, before time seals over the gap in our minds left by the person whose memorial it is and we concentrate more on the person who gives the lecture.

Two years after Chris Evans' death, the second Chris Evans Memorial Lecture has attracted the wise old man from *The Guardian*, Peter Large, who will talk about computer technology and printing ('*The Times*, they are a changin'), a lecture I wish I could have told you about before it happened. Large is one of the gems of the computer-watching business, being that rare beast, an older man, sporting grey whiskers and a benevolent twinkle behind which he hides a marvellous investigative brain.

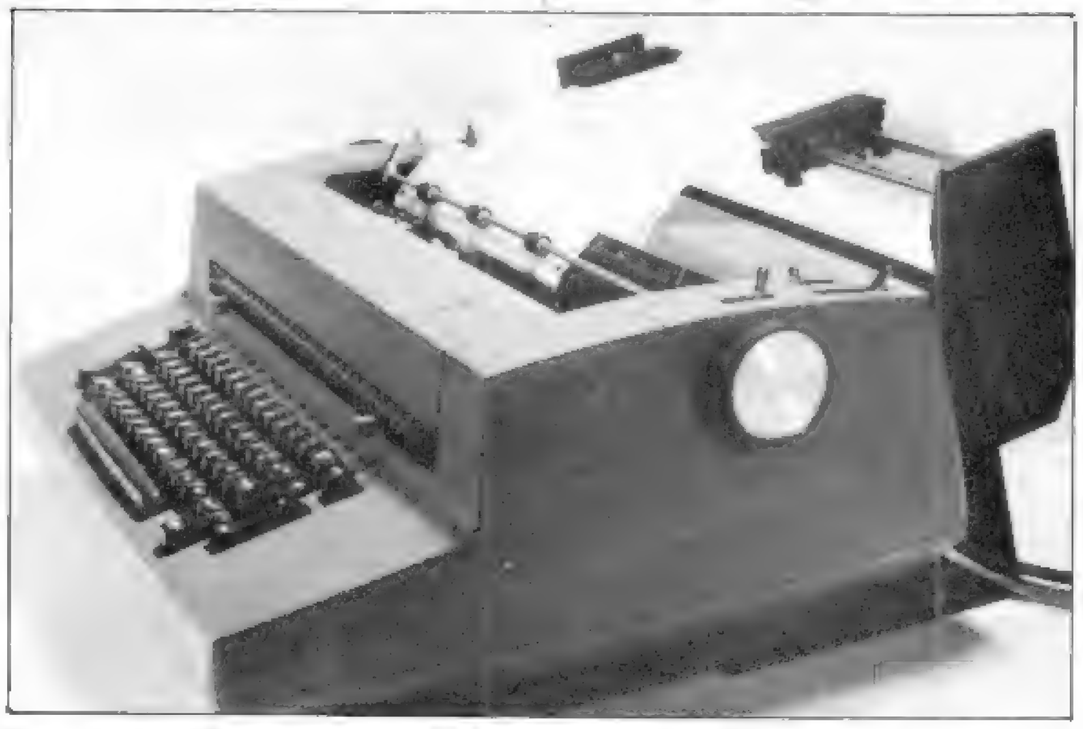
Had the announcement reached me in time to give you warning I would certainly have done so, even though the lecture is part of a £80 series of lectures at the London Regional Management Centre. The original TV series which Dr Chris Evans himself made to go with his book, is also available now — on video cassette — for £39.95. Distributor is EnterVision, tel 01-353 0186.

Reading lessons

The Personal Computer Palace is a shop. It is a shop worth mentioning because it aims to be the kind of shop 'where people can walk in and play with computers to their hearts' content.' The computers are Apple and Video Genie; other stock includes chess games, educational games, software, books and magazines. It's at 6 Castle Street, Reading, phone 0734 589249 — just follow the hordes of truanting schoolkids *(and see ComputerTown News — Ed)*.

Monopoly magic

I worry about 'efficient' estate agent software. Last time I was buying a house, I noticed a strange thing — no matter how carefully I described the *type* of house I wanted, the agent homed



Resist, at all costs, the temptation to look angrily at that expensive electric typewriter in your office and say 'I can recover the vast amount of money spent on that by converting it into a computer printer, which is what I wanted really.' The cost of converting it starts with the cost of a plug-on set of actuators, continues with the fact that some such kits actually cover the keys, so you can't type any more and doesn't even end with the problem that no electric typewriter was ever designed to take the battering of continuous use and will shake itself to pieces in months. The last straw must be the need to buy this little 'feeder' which feeds the paper into the platen, stopping the weight of continuous stationery from pulling unevenly and slipping on one side. It costs a mere $150 from San Mateo company McAnn at PO Box 3173, CA 94403, USA, phone (415) 349 1229.

directly in on the *price* of house I could afford. I could get round that by knowing the area I was moving into and asking if there were any houses in that street and (inevitably) ended up with a house which was bigger than originally planned but actually cost less. From the agent's point of view, however, something like Monopoly, a program from Business Simulations, must look like a winner — it matches houses and also helps in estate mangement. And anybody who has the chutzpah to call a property management program Monopoly is going to get a mention here just for cheek. Details on 0892 86 3105. It runs on Alpha Micro system.

Tandy speech

There is a software company in California which likes the Tandy speech synthesiser but doesn't think much of the software Tandy has provided for making it talk. So it has set up as BAYSIK SPEECH, selling 5.5 kbytes of machine code which adds a much smoother control program to the machine.

With SAYIT, the voice synthesiser is programmed using English letters. In many cases, normal English spelling will be pronounced correctly but when this causes strange pronunciation, 'soundspelling' is used to force correct speech — for instance Basic sounds better spelled BAYSIK. Contrast this with the coding needed using the Radio Shack (Tandy) software: "B"+CHR$(94)+"S K".

Details from Suite 289, 1259 E1 Camino Real, Menlo Park, CA 94025.

Gurrow

Just because I don't buy much software shouldn't be taken as an unconditional guarantee that, when I do pay money for code, the code is terrific. I did buy GROW and the code is pretty good; however the documentation is as lousy as all other micro software in this category. For $35 (£40 in this country through Mike Gurr) what do you get?

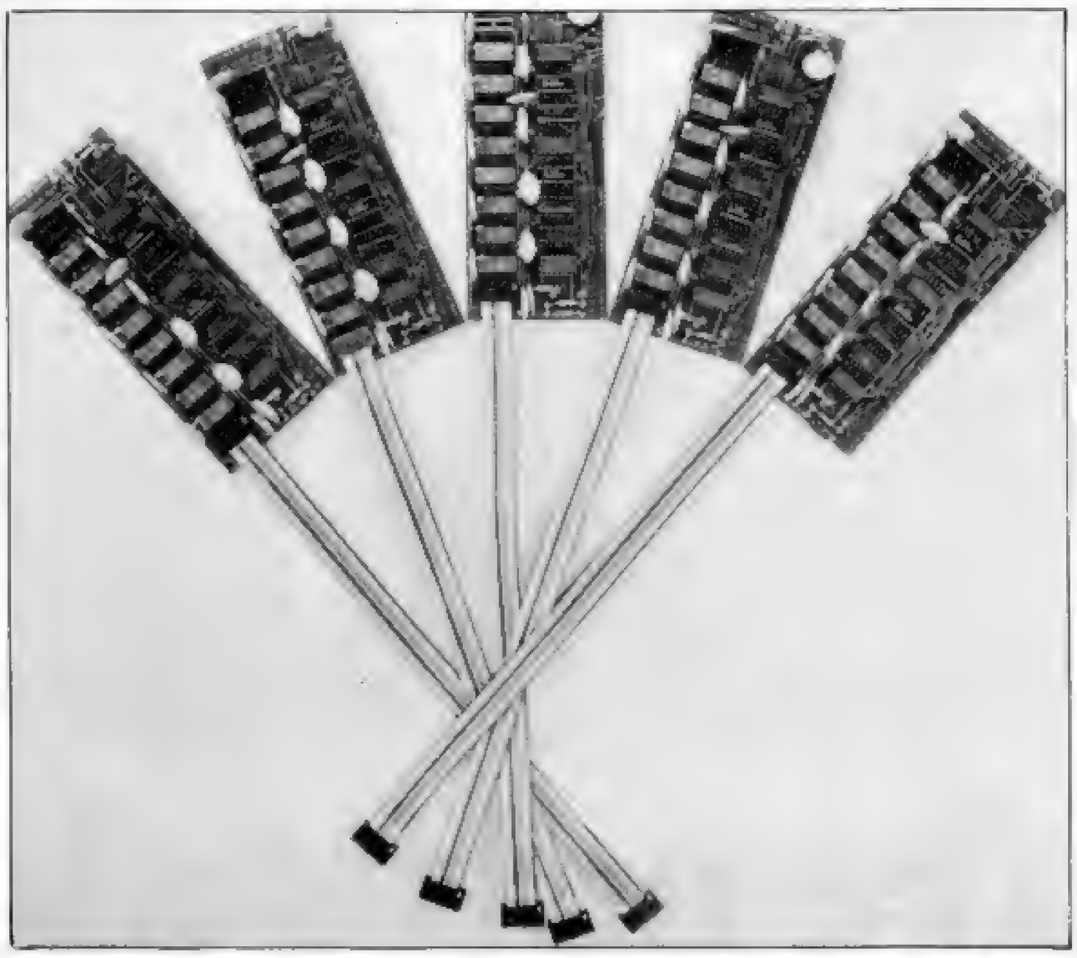
A knowledge network links various 'answers' and allows decisions to be built in. Two good examples are a computer-aided instruction sequence and a fantasy game.

Grow does both, quite well. It comes on a disk, for Apple or NorthStar Horizon. You start by going into various 'rooms' and obeying instructions there, like learning a lesson, or walking through a dungeon master's maze. Grow, however, allows you to EXTEND each room. You can have new questions, new answers, new calculations of response, as you see fit.

In a game of dungeons, this causes some confusion for other players, since a room which they visited previously and did certain things quite safely, may suddenly be full of dangers.

For a teacher, it means that you aren't stuck with wrong 'wrong answers' (or 'right answers') for ever. The software can be grown onto new disks, too, using the Gardener package, so that you can set up new networks using the operating software available on the master disk.

Its potential, Mike told me, is immense, and I'm sure he's right, but I wish he could get a better deal with Computer Systems Design Group of 3632 Governor Drive, San Diego CA 912122, (415) 856 1954, because I rather resent the £40.



With Apples selling in the UK at 1700 per month (and rising) the market has reached the point where it becomes worth it for UK manufacturers to make Things To Go Inside. Like cheaper add-on memory, for instance. Cheaper add-on memory is the first product from U-Microcomputers, in the form of a 16 kbyte card costing £130 (£99 in kit form). This will be 'the first of a range of UK manufacture accessories'. It's available through Apple dealers, and details are on 0925 54117.

Big Swede

Swedish users have bought nearly as many ABC 80 micros from Sattco as the British have bought Nascoms — and the Sattco machine is much more expensive, so clearly it has something. Sattco has accordingly followed it up with a big brother — the ABC800 — with a higher class display, the option of a full colour display and a high resolution (240 by 240 dots) display for graphics. It also has a bigger Basic interpreter and can be expanded beyond the normal restriction of 64 kbytes of memory of the Z80 micro. The company promises that all software from the old machine will run on the new.

Details from the UK agent, Datormark, on Weybridge (0932) 44896.

Card collection

The beauty of the S100 system of computer cards is that you don't have to buy someone else's design; you can go through the catalogues, picking a processor card here, a memory card there, an I/O card, a speech synthesiser and so on and so on. You put them all together, and they turn out to run at different speeds, to use line 27 for different purposes and to screw themselves up solid. This explains why Sintrom has produced a box and a series of Periflex 2 cards to go inside. Details on (0734) 85464, to establish that they are all compatible with each other.

Telex link-up

People with good word processing software are normally forced to return to the Stone Age every time they use the British Telecom Telex network, with no control over the input, so a software package to link the two should have powerful appeal.

The Word Magic package has now been linked to Telex by Small Information Systems Company and to the mix, SISC has added a computer monitoring feature: the machine will, if it has enough data storage, send and receive telexes after hours with nobody in attendance. To do this, it does require a 10 megabyte hard disk, and the whole package is costly, at £9,000 including a good printer and all software. Details on 01-920 0315.

DoI Broadside

There is absolutely no earthly way that government departments can support British microcomputers by insisting that only British micros are used in their offices. Like it or not, it is stuck with the fact that certain American machines, like the Apple, are standards in themselves.

Where British manufacturers feel that the Department of Industry has gone too far is in excluding perfectly good British micros which it already has several copies of scattered around the country. David Broad builds a microsystem called the Communicator which is now virtually debugged and several of which he has sold to Government departments and local authorities. Suddenly, this machine is 'not approved' by the DoI. Neither are several other machines which are known to be reliable, widely available, and widely used.

One can sympathise with the DoI in principle: the idea of having a few, easily identified machines approved means that servicing them is a problem of known dimensions. You only have to train your engineers to cover the ones in the list and you can buy software in bulk. But, of course, it doesn't work quite like that. For a start, it's easier to guarantee that CP/M software will run on a given CP/M machine than PET software will run on a given PET.

David Broad takes the diplomatic stance of saying that it's all his fault (and that of his fellow British manufacturers) for being 'too low profile.' It's nice of him to be tactful and it may do him some good, too, but it isn't altogether the truth to blame 'low profile marketing' for the fact that the DoI's Central Computing and Telecommunications Authority deliberately advertised on a minuscule scale and with a misleading turn of phrase, with what I know, from inside sources, to have been the overt intention of *not* attracting too many people. The work of sorting them out, you know — quite frightful.

Broad's group aims to 'widen the Computer in Schools scheme and to extend it to many parallel application fields that will be vital in the regeneration of economic activity.' He also thinks that as well as a computer in every school, we should be aiming for a computer in every business.



You're never alone with a Commodore PET

If you buy just any make of microcomputer you could find yourself on your own. And that's serious. Because without first class software and support, all you're left with is a box of wires.

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Cashing in

By now the cash register business will have noticed that people don't want to spend a lot of money on a cash register but are prepared to fork out quite a bit more on a cheap computer. It must annoy them. One cash register maker has decided to cash in on this by selling a cheapish (£3500) micro-system with floppy disk and video display, which is also a cash register. In addition, the firm (Anker Data Systems) has designed its new machine so that it can control several of its older models and it can work in betting shops as well as supermarkets. After all, it is a computer. Details on 01-947 1378.

Apple printers

A printer costing £300 for the Apple has been released by Micro Peripherals of Basingstoke as one of three new printers with a price appeal. The MX 70 gives 80-column print and can copy the Apple's high resolution display dot pattern; the MX 100 costs £600 but gives 136 characters per line and is faster, while the MX 85 will copy any video screen and the price is obviously too frightening to publish, because Micro Peripherals has kept it to itself. It will send print samples for each printer but it seems clear that the one thing these matrix printers can't do is imitate the intensity variances of the graphics screen. Few printers do. Details on (0256) 56468.

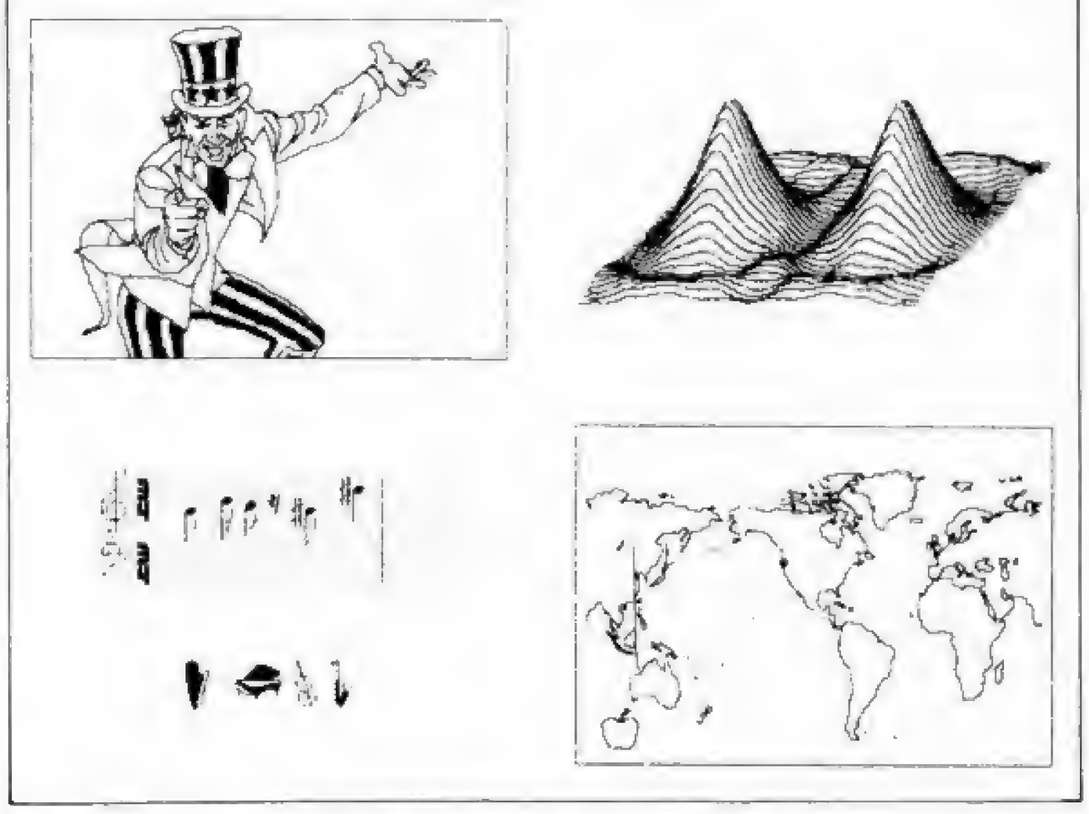


People don't often cause a stir in this column unless they've just become bankrupt, or been appointed nineteenth exclusive nervous breakdown to a Japanese anti-trust micro company, but the bespectacled face of Steve Feldman is one which deserves a little flash.

He has joined Alan Wood, one of the more influential movers in the micro business, at Wood's company Digitus. And he is setting himself up as an expert-to-be on networking systems.

*He is an old hack in the computing business, having been around for 20 years, and what makes him special isn't his expert knowledge of networks (he readily admits that, so far, he has little), nor the fact that I've asked him to write a regular column for my other paper (*Datalink*), but his enthusiastic abandonment of the doldrums of old-fashioned computer-room activity for the buzz of the micro world. He has actually done a lot of micro work for his old company, Data Logic, but my honest opinion is that it was all done with the old mainframe/mini hat on. Now he's getting into the retail end of the business and there's an object lesson there for other old hacks, if they care to watch.*

Incidentally, he was one of the founders of that ultra-respectable old-world software house Logica, so his departure from orthodox practices isn't due to ignorance or under-achievement. Just recognition of where the wind blows.



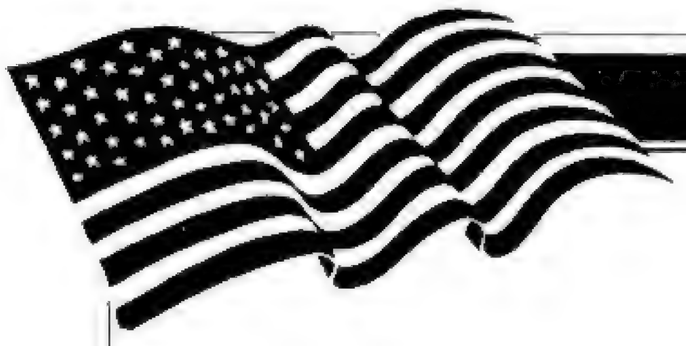
These fascinating pictures can be drawn on the Apple II screen, using its high resolution graphics and quite a bit of sweat. However, getting them onto paper isn't too easy unless you have the right printer — hence Stack Computer Services' decision to produce a new circuit card, costing £140.

In normal use it behaves as a standard printer controller (Centronics interface) but it also has software built in to interpret and print the contents of Apple's two high-res graphics screens on 'most of the popular matrix printers'. Additional commands allow the user to scale the output, put it to the left, or the right, or the centre of the paper, or to invert the image. Details on 051-933 5511.

Tepid grovel

Trying not to feel too guilty about a tepid welcome I gave to a Guild Sound and Vision training package on video tape, I think I'm going to make myself a small excuse. It has no computer as part of the video course and the bit of the publicity which suggests (as I did) that using a computer was essential didn't get to my desk.

That's the excuse; I'm pleased to say that GS&V has politely put me right and insists that the course needs a computer.



YANKEE DOODLES

Tom Williams reports on the American side of the microscene

Ten megabytes on a single side of an 8in floppy disk are certainly going to make a name for Iomega Corporation, 4646 South 1500W, Ogden, Utah 84403. Such an improbable storage capacity on a floppy is made possible by two techniques: an improved high-density oxide formula by 3M Company and a crafty method of making the flexible disk rigid while it is spinning, thus enabling the head to be positioned very close to the disk surface. The head never contacts the disk as in normal floppy systems.

The Alpha 10 disk subsystem accepts floppy disks contained in cartridges. When a cartridge is inserted into the drive, a door in its end is pushed back and opened and the disk is positioned on the drive spindle. Above the disk is a metal plate with a slot in it through which the read/write head has access to the disk. As the disk spins, it tends to force itself against the plate. This is counteracted by air drawn through the drive spindle and out between disk and plate. The head itself is contoured so that the constant airflow caused by the rotational speed assures a stable head-to-disk flying height. The rotational speed is 1500rpm, or half that of a Winchester disk. The air flow also works against contamination because the flow tends to carry particles around the head rather than directly over it. The people at Iomega say they have repeatedly blown smoke into a running drive with no ill effects.

Disks are preformatted with embedded servo information. Formatting consists of 306 tracks of 70 sectors each. Each sector, however, contains two 256-byte data fields so that the controller can be told to act on logical sectors of either 256 or 512 bytes.

'Radio Shack seems to have done it again...'

On the networking front, Radio Shack seems to have done it again. It has announced a number of hardware and software products that will allow anyone to set up miniature Videotex system. Minimally, a 64k TRS-80 Model II can be used with a modem/multiplexer that will handle up to 16 phone lines simultaneously. The software allows pages of information to be stored on disk as in the Prestel system and will handle user requests for presentation of pages.

For convenient data base updating, another TRS-80 Model II can be used to collect data from Information Providers and to quickly update the other computer without disturbing the users. The addition of a software-controlled switch, called the Network Three, allows additional database computers to be added to the system — each serving up to 16 simultaneous calls — which can also be serviced by the same update computer.

Local networks are also proliferating these days. The Nestar Cluster/One is well known, as are the higher-end networks such as Z-Net and Ethernet. But a relatively low-cost local network scheme which will allow up to 64 small computers of different types to be placed on the same net has just been announced by Corvus Systems, 2029 O'Toole Ave, San Jose, California 95131. Called the Omninet, the network uses a single twisted pair of shielded cables which can be up to 4000ft long and transmit data at a rate of one megabaud.

The key to the Corvus Omninet is the interface card called the Transporter. Different Transporters are being developed to fit into the bus of a large number of popular computers, among them Apple II, S100, TRS-80, Zenith, DEC LSI-11, Altos and more. The Transporters differ only in that part of the circuitry which interfaces them to a given bus scheme. On the side facing the network bus (that simple twisted pair), they are identical. That part of the card consists of a 6801 microcomputer with on-chip ROM and a custom gate array chip. This part of the circuit takes commands from the host CPU, telling it which part of host memory to send data from and to which of the other computers on the net to send it. The transfer is a DMA out of the host's memory and that data is sent in serial form along the line to the other Transporter, which accepts it in serial form and puts it in its host's memory via DMA.

At present, Omninet can be readily used with Apple IIs in conjunction with Corvus' Constellation hard disk system. The Constellation is a system that lets various computers share the resources of a hard disk. Constellation software arbitrates requests for disk access, maintains files and the like. What the Omninet does is allow a large number of machines to share a single line. The difference between Omninet and a local network like Nestar's is that there is no network master, so that if one machine goes down the others are unaffected.

This also means that there is a great deal of software to be written in order to utilise all the possible ways the transporters could be put together; the Constellation scheme is only one possible configuration. Corvus has said it will be quite willing to supply serious software authors with the necessary information to write systems programs to use Omninet. Future addition to the Omninet will consist of peripheral 'servers' — intelligent interfaces using Transporters and allowing the Net to share expensive equipment such as printers and hard disks. Corvus will also make 'gateways' to other networks, both other Omninets and other types of network such as Ethernet.

All this brings to mind the subject of standards and synergy. There was a time when companies were a great deal more paranoid about maintaining absolute control over the products of their own brainpower than many today seem to be. The classic example, of course, is IBM, who spends untold millions trying to make it impossible to use any equipment with IBM machines than that made and blessed by 'Big Blue' herself.

'This business of networking ...demands compatibility..'

This business of networking, however, demands compatibility in order for anybody to have any success at it, hence the initial decision of Xerox, Intel and DEC to collaborate on Ethernet - a standard which has yet to become fully defined. On the other side, however, the need for local networks was so great that people simply couldn't wait for a standard to be hammered out in dreary committees. Thus we see an increasing number of companies going ahead and implementing their own local network schemes which may be specific to that implementation on one level, but which are looking forward to a future general standard in which all can participate.

Thus, Zilog is not only implementing Z-Net and trying to make all future products compatible with Ethernet, it is providing information on its own hardware and software products to other manufacturers who wish to make such things as computers and printers easily usable on Z-Net. That way everybody wins. The products are sold to Z-Net users and Z-Net gains in acceptance. And, more importantly, the broader future goal of full Ethernet compatibility is not excluded, even if that means compatibility upward through special gateway devices. We can have networking now and Ethernet later and yet not give up valuable hardware and software investments.

Preserving those investments is becoming a watchword among the more responsible manufacturers. They take a go-slow-but-sure approach and are no longer bedazzled by the latest technological widgets. If a new product means the customer is going to have to scrap years of investment in programming, the chances are he will not be interested in the new goodie. Altos Computers, 2360 Bering Dr, San Jose, CA 85131 has noticed that its customers are quite willing to wait for new developments because Altos has instilled in them the confidence that when the new product does arrive, it will be backward compatible with all the things that the customer is already using. Of such things are great fortunes made.

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NEWS

ComputerTown UK! is a nationwide network of voluntary computer literacy centres. All letters should be addressed to: **CTUK!, c/o 14 Rathbone Place, London W1P 1DE.**

Fantastic news — this month another six ComputerTowns have started up! Heartiest congratulations to those responsible. Let's have a look and see who they are.

First of all, Alan Waring and David Clark have started ComputerTown Enfield at the Ridge Avenue Library. Keep your eyes peeled for notices in the library or contact Alan at 50 Drayton Gardens, Winchmore Hill, London N21, telephone 01-360 8020. David can be contacted at 14 Haughmond, Woodside Grange Road, Woodside Park, London N12, telephone 01-445 5324. *PCW* contributor Alan Tootill was one of their first volunteers.

ComputerTown Street (in Somerset) has now started up and it holds meetings every Monday from 6.30 to 9.30 at 19a West End, Street. Tom Graves is the man responsible, aided and abetted by Beaver Systems, Mutek, Norset of Cheddar and Somerset Computers. Sounds like a really nice part of the country to be in if you're a computer freak. Tom's phone number is 0458 45359 and, if that seems familiar, it's because he's a leading light in the Ohio Scientific UK User Group and the man behind Wordsmiths.

Brigitte Gorton wrote from New Addington to say that she'd 'been galvanised' into starting a ComputerTown, New Addington every Thursday afternoon at 3 o'clock. I guess it's being held at the local library but her letter doesn't say. Brigitte can be found at 18 Pirbright Crescent, New Addington, Croydon CR0 0RT.

Gloucester, too, now has its very own ComputerTown. Steve Haynes is the man who started it and it runs in the Hucclecote Community Association's premises. Steve is also starting a users group so if you're interested in either or both then contact Steve at 5 Guinea Street, Kingsholm, Gloucester GL1 3BL. No charge will be made for CTUK! meetings and a nominal fee will be charged for user group activities. In this way the user group can pay for hire costs and use of the HCA's facilities both for itself and for ComputerTown.

We had an interesting letter from Keith Taylor from the finance department of Renold Ltd. Keith has been doing his bit for computer literacy within his company of about 400 employees. He asked if his group could join CTUK! — we don't mind who joins as long as they are genuinely involved in the spreading of computer awareness on a non-commercial basis. Already a number of computer clubs have written to say that they've been running similar schemes for some time now. That's great — there's no need to call yourselves ComputerTown, it's what is being done that is important. ComputerTown is a handy name which new groups can use and to which existing groups can affiliate themselves if they want to. Renold's offices are at Carter Hydraulic Works, Thornbury, Bradford BD3 8HG. I think a letter would be better than a phone call since that is Keith's business address.

Caversham Park Village near Reading is now the proud owner of a ComputerTown. This one was launched by Pat Colley in the premises of the Caversham Park Village Association. Douglas Milne of Personal Computer Palace in Reading heard about Pat in *PCW* and turned up with an Apple to help out. Other dealers please note. As long as you don't try to sell your wares, you'd be more than welcome at any ComputerTown. You may even want to start your own — write to me if you need any guidance on setting up.

Last month I went to visit ComputerTown, USA! and the people there are thrilled to bits with all your efforts. CTUSA! shared a stand at the West Coast Faire with People's Computer Company, probably best known for its *Dr Dobb's Journal*. I've fixed for all new ComputerTowns to receive regular copies of the CTUSA! monthly bulletin. CTUK! will also be exhibiting in September at our very own *Personal Computer World* show. Anyone who wants to help out should get in touch with me very soon, since by the time you read this the show will be less than ten weeks away. As I said last month you'll have to pay (or scrounge) your expenses, we can only provide the stand and its facilities.

I've finally got the ComputerTown records 'computerised' so now I'm working on a comprehensive document to help all would-be ComputerTowns to get off the ground. It includes a draft constitution which can be adopted by any ComputerTown simply by filling in the blanks with appropriate details. I am indebted to that well-known barrister Alistair Kelman for his help with this. Alistair has already told me how to set about things and he will be checking over the final draft to make sure that everything is covered. The document will also give practical help on the actual running of a ComputerTown taken from our collective experiences. If you feel that you have any hints and tips to offer then please send them to us. Don't worry that we may already have covered the same ground; I would far rather receive information twice than miss it altogether.

I said last month that I'd bring more news of ComputerTown Horsham. Well the news is that Andrew Holyer is running the show every Saturday during term time at Forest Boys School in Horsham. In common with most 'Towns, the first session was very quiet but word quickly spread and it is now wildly popular. I also promised further information on the Cedar project — Judith Morris runs this from Imperial College Computer Centre, Exhibition Road, London SW7 2BX, telephone 01-589 5111 extension 1160. The project exists 'to encourage teachers to examine the possibilities of educational computing, to recognise its contribution as a solution to some of their problems and to facilitate the development of appropriate educational tools'. The project maintains records of all relevant books and papers as well as details of existing CAL packages. Seminars are organised and demonstrations given. In this column I can only give the briefest of overviews; if you feel you'd like to know more then I'm sure that Judith will be delighted to hear from you.

ComputerTown found its way into a magazine called *Training Action*, and a very nice write-up it was, too. Editor and writer of the article, Leo Jago, described CTUK! as 'the fastest-growing voluntary organisation' and he should know since the magazine is the house journal of the National Council for Voluntary Organisations. They can be found at 26 Bedford Square, London WC1B 3HU, telephone 01-636 6039.

Other people this month who'd like to help or set up ComputerTowns are: Gary Quinn of 52a Guisborough Road, Moorsholm, Saltburn by the Sea, County Cleveland TS12 3JA; David Lee, 184 Hill Lane, Southampton SO1 5DB; Michael Lee, 22 Newlyn Drive, Sale, Cheshire M33 3LE; (what a coincidence — apart from the fact that both these gents are called Lee, one is a physicist and the other a physics teacher!); Mr J B Hawkes, 10 Windermere Close, Aylesbury, Bucks HP21 7HP; R L Saunders, 14 St Nicholas Mount, Hemel Hempstead, Herts HP1 BB, telephone Hemel Hempstead 51910. I'm sure that every one of these people would welcome contact with others who feel they'd like to help.

Finally, we've had letters from people interested in ComputerTown in the following areas: Walton on Thames, Salisbury, Rinteln: BFPO 29, West Malling, London W12, Birmingham B29 6NB and Harrow.

Thank you all once again for this splendid support. If you'd like to help with a ComputerTown then write to me (David) at the main CTUK! address and I'll send you some guidelines or put you on to a nearby ComputerTown. Keep in touch with us as things develop so that we can give your activities publicity through ComputerTown News. Remember, all letters which need a reply should be accompanied with an SAE and please *don't* try to ring us at *PCW* because CTUK! is a spare-time project.

COMMUNICATIONS

PCW welcomes correspondence from its readers but we must warn that it tends to be one way! Please be as brief as possible and add "not for publication" if your letter is to be kept private. Please note that we are unable to give advice about the purchase of computers or other hardware/software — these questions must be addressed to Sheridan Williams (see 'Computer Answers' page). Address letters to: 'Communications', Personal Computer World, 14 Rathbone Place, London W1P 1DE.

Linsac letter

In his review of *The ZX80 Companion* in April's *PCW*, Peter Turk described the book as 'accurate and detailed' but quoted a price of £10 as 'a bit steep'; in fact, the price has been £7.95 for several months, and it was unfortunate that our advertisement in the same issue also suffered the attention of printers' gremlins, the price being omitted!

For your readers' information, we now supply a 20-page ZX81 supplement with the *Companion*, including programs and tips on the 8k monitor. A large stamped addressed envelope will bring full details of all our ZX80 and ZX81 products.
Bob Maunder, Linsac, Middlesborough

Protection points

With reference to Mr R E Bailey's letter and your comments thereon in your April issue, I should like to make some observations for general consideration.

Firstly, I must point out that the Courts have *not* yet decided if Copyright extends to Software, although if the expected Green Paper on Copyright follows the Whitford recommendations any new Copyright Act may get as a result will probably extend Copyright to Software.

Secondly, Copyright protection covers the *expression* of an idea *not* the idea itself. The explanation of how to produce a game cannot be monopolised through copyright, only the expression of the idea in, say, the software listing. Patent protection is the only way one can protect the 'industrial application' of an idea.

Thirdly, the restricted acts specified by the Copyright Act 1956 which are relevant in this case relate to the reproduction of the work or an adaptation of the work or the making of an adaptation of the work. The onus is on the Copyright owner to show that copying has occurred and it must be remembered that independent creation of a program involving the idea is an infringement of the protected work.

Fourthly, the Copyright Act 1956 includes at Section 2 subsection (6) definitions as to what is an 'adaptation' of a literary work. It is widely assumed that Software will be accommodated under the term 'literary work', although it may be that flow diagrams will be accommodated under the term 'artistic work'. Included in the list of defintions for 'adaptation' is 'a translation of the work' and it is considered that translation is not to be limited to a different language from the original work. Under these circumstances, it seems clear to me that the mere 'translation' of the original program listing so that a 'new' program is produced which will run on another machine would be held to be an adaptation of the original literary work and is, therefore, a restricted act which if performed without the permission of the Copyright owner would be an infringement of the Copyright in the original work.

Finally, I wonder if I might enquire through your columns if there is any great depth of desire for a legal system which would provide protection for the implementation of ideas in software packages. On this theme it is clear that the Patent system in the UK can be used to protect *a product* when operating in accordance with a program package as long as the product includes an invention which is 'new, involves and inventive step, is capable of industrial application and the grant of a patent for it is not excluded by the Act'. As a matter of interest, although the Patent on such a product does not extend to the program per se, Section 60 (2) defines that the supply of an essential element of the invention is an infringement of a patent. I am of the opinion that the supply of the software listing of a program, which when loaded into a suitable hardware arrangement, caused a product to be produced which infringes the claim of a patent, will be held to be the supply of an 'essential element' and will therefore be an infringement of the patent.
R J Hart, Liverpool

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Help us to help yourselves and hundreds of would-be members of clubs and user groups who are being lost to our movement through lack of information about those organisations. The Amateur Computer Club — the first computer club in the world, founded in 1972 — is your own national body. Among our more important services we are building up a comprehensive database of clubs and user groups. The ALCC has generously passed over the intial data used at its Easter fair and we are allocating 1k per group/club. At least 100 groups are missing and much of the present information is out of date. Will officers therefore provide data in two parts: concise details, contact addresses etc for wide publication; and supporting information about your activities to help us spread news and represent your views nationally.

We have made another breakthrough by obtaining a large club area at the *PCW* show; a lot of groups have already booked free space — but a lot of room is still available.

We will provide full details of the above and other activities such as our two Autumn conferences, or networking and small robots and Micro Mouse, if you contact me (preferably with feedback with other things you expect from your national body):
Vernon Gifford, Planning & Liaison Office, ACC, 11 Selhurst Rd, London SE25 6LH; tel 01-653 3207.

Magic wand

As a dealer supplying the Magic Wand package, we were very pleased to see the review of the system in your May issue. Unfortunately one of the few complaints made by your reviewer, that file sizes are limited by the size of the text buffer, is not in fact a restriction imposed by Magic Wand. The system can handle file sizes of up to the CP/M limit, and the read and write commands displayed in the illustration in your review are used to manipulate files larger than the text buffer.

The review also said that the spooling system gave priority to the printer. This is necessary to ensure that Magic Wand works in all CP/M environments, but as the manual states, 'your dealer may be able to make a minor change,' which will in effect reverse the priorities.

The only other major omission from what was otherwise a very thorough review is the fact that Magic Wand now supports proportional printing elements on daisywheel printers, allowing different spacing for each letter.

Since your review went to press, the Magic Wand system has been acquired by Peachtree of Atlanta, Georgia, and is now fully supported by that company. They have issued a new release of Magic Wand, version 1.11, which corrects a number of very minor bugs in the last version from Small Business Applications Inc.
Tim Frost, Roundhill Computer Systems, Marlborough, Wilts

Zilog writes

My attention has recently been drawn to an article which appeared earlier this year in *PCW*. The article in question was a review of the Onyx C8002 microcomputer written by Sue Eisenbach.

While not being in a position to comment on the Onyx C8002 system itself, I should like to clear up several inaccurate and misleading statements which were made in this article concerning Zilog's Z8002 family microprocessor products.

1. While talking of the Z8000 your article states: '. . . originally it was designed to be supplied in two versions: the Z8001 had a total of 45 distinct instructions. . . and could address 8 Mbytes via memory management hardware while the Z8002 had. . . slightly fewer instructions.' There are several errors in the above statement:
a) It is true that the Z8000 is supplied in two different versions; the Z8001 and Z8002. The difference between the two is in the size of memory that can be directly addressed. The Z8002 which addresses a smaller, 64 kbytes is packaged in a smaller, lower cost package, making it a lower cost device. However, the chip is identical in both Z8001 and Z8002, the difference being achieved by a bonding option during manufacture. Consequently both parts have always been equally readily available from Zilog.
b) Both Z8001 and Z8002 have identical instruction sets of 110 basic types which may be combined with the various addressing modes to give over 400 different opcode combinations. Larger address values, of course, exist in the Z8001 instructions due to the larger address space. In all other respects the instruction sets are binary compatible.
c) The 'memory management hardware' is a separate

component which may be used with the Z8001 to help manage the large address space. It is not essential to use this as the Z8001 can address 8 Mbytes without the Memory Management Unit (MMU). However, the MMU provides powerful memory segmentation and protection features to assist in the management of large address spaces.
2. Your article mentions a third version of the Z8000 which we have announced. This is the Z8003 which will be available early next year. It is a further enhancement which will be fully compatible with Z8001 but provide virtual memory support. Contrary to the impression conveyed in your article, the various Z8000 versions represent a deliberate policy by Zilog to provide a range of price and performance options while at the same time providing compatibility across the range and a growth path for the future. Surely this is desirable.

I hope you will take action to correct any misunderstanding which may have been created in the minds of your readers.
Phil Pittman, Zilog (UK) Ltd, Maidenhead, Berks.

Elvers wanted

I am writing to you in a desperate attempt to try and contact another owner of an ELF II (if one exists!). I was looking through several of my magazines, which consist mostly of your great magazine, and I didn't see a letter or program to do with the ELF II. Is it that we are extinct or endangered species and afraid to speak out?

I have been computing for two years now and I bought the basic ELF II a year ago with some money that I had for Christmas. With the release of the Sinclair ZX80 and now the '81 it is very frustrating to know that I have spent over £150 and I still don't have a system equivalent to this, but rather than sell my ELF II, I am going to stick at it and hope that there is another ELF owner out there who would be willing to exchange programs with me.

I am a computer freak but I cannot think up hundreds of programs and have great difficulty in writing machine code programs. I am willing to pay for software and I would be only too pleased to write programs for other ELF owners, especially as I have now got Basic.

I have been looking for a job in computing, as I am 16, and I have had no luck, but I am determined to keep in the computing industry and perhaps I will get a job as a trainee somewhere, but while I stay on in the sixth form with the free time that I have I write programs for my ELF and I feel that if someone can have fun with one of my programs then why shouldn't they. I do hope that you can help me as it would be helpful to be able to talk to someone who understands 1802 machine code instead of the usual 6502 or Z80.
Tony Higham, 24 Linford Crescent, Coalville, Leicestershire

Basic balance

Basic has recently taken the brunt of much undue criticism in the computer oriented press. In writing this letter I hope to look at both sides of the argument in a few simple statements.
1. The great majority of readers of this magazine would not be doing so if Basic were not the 'standard' language. Basic has 'humanised' the computer.
2. Any Pascal devotee should try convincing a 14 or 15 year old that he should abandon Basic in favour of Pascal. To use Pascal effectively requires deep thought and careful planning that many enthusiastic children cannot yet be bothered to do. Computers will be used extensively in the future and we should not raise barriers (such as the requirements of Pascal) to the everyday use and acceptance of computers in our society.
3. We must remember that Pascal too has a few badly thought out features, one such being the use of :=. Many users of Pascal treat this as an improvement, because it removes the ambiguity of statements such as:
IF X=4 THEN Y=Z+3
But where is the ambiguity? The IF part is clearly a condition and the THEN part is clearly a consequence. A wily compiler should distinguish between these. Since when were primary school children taught that 2 x 3 := 6 ? (or is this already in hand?)
4. There has been much criticism of interpreters compared with compilers. A compiler is useful for the fast running of perfected(?) programs, but it is an obstacle if a program is merely being developed. It can take three or four minutes to insert a missed space or colon (about which Pascal has very tight rules) and get the program running again, but with an interpreter it takes only a few seconds to correct the error. A compiler could then be used on the finished product.

So what should be done? A structured Basic seems the best idea so that one can progress from simple Basic to structured Basic without the need to learn a whole new language. After all, we do want people to use computers, don't we?
Jonathan Palmer, Currie, Midlothian

Manual moans

Why are computer and software manuals so predictably awful?

We seem to have tested a sackful of manuals recently for our new Pet 8000, in normal office conditions with secretaries unfamiliar with computers. The result? Every manual contained a major flaw or, in some cases, was totally incomprehensible. After three months of largely futile experimentation, we have now written our own 'manual' for the Wordcraft program. Otherwise, we simply could not have used it.

The appalling documentation for the Pet itself is well known — most of the instructions are simply unintelligible. But less discussed perhaps are the inadequacies of the manuals for the Sinclair ZX80, OZZ and DMS data management programs. The manual for Wordpro 4 is virtually incomprehensible, and was the sole cause of our refusing this program.

Some programs romp along cheerfully for a few pages, giving the illusion that here is a manual that can be actually understood. Then either the printer advances his schedule or the writer succumbs to programmers' elbow, and vital instructions are telescoped into an impossibly short space. For example, the ZX80 manual includes some of its more important functions in a tiny chapter 'A ragbag of functions'. It mentions 'arrays' in a paragraph, without explaining what they are or why they are used, then leaves the hapless purchaser struggling with sundry functions like RND (what? why?), before signing off — with no indication of what he can now do with the computer by way of games, programs, etc.

The OZZ manual is beautifully laid out, but unless you are a stock control clerk, the example programs given are valueless — and little help is forthcoming in using the program for more advanced functions, eg survey analysis. DMS leaves the layman struggling after page 6. Even Wordcraft, one of the better manuals, contains nonsense instructions that, if executed literally, are rejected. And so on.

Can I suggest to all manual writers this simple routine: 'Tell it to Bridget'. Select a lay typist unfamiliar with computers. Give her the hardware and manual for a weekend. Then prepare your blushes for a list of protests and queries. And, please, never never release a manual on the market until several non-specialists have debugged its computerese and unexplained leaps of logic.

Or is this too simple for the rapacious 'launch now, apologise later' world of micro-computer?
Nick Robinson, Luton

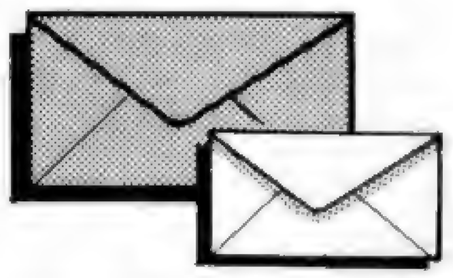
On-line

Alan Sutcliffe (Letters April 1981 issue) presents a less than fair picture regarding the position of online information services in Britain.
The British Library has had a highly successful operational online information retrieval service since 1977. This service called British Library Automated Information Retrieval Service (BLAISE) offers access to files a) with comprehensive coverage of the journal literature of medicine and toxicology and b) with comprehensive coverage of all books published in the United Kingdom since 1950 and in the United States of America since 1968. The software, ELHILL, for this service was developed by the National Library of Medicine in Washington but the British Library has also developed its own software, EDITOR, which enables libraries to edit and create records for their catalogues which are ultimately available on microfiche.

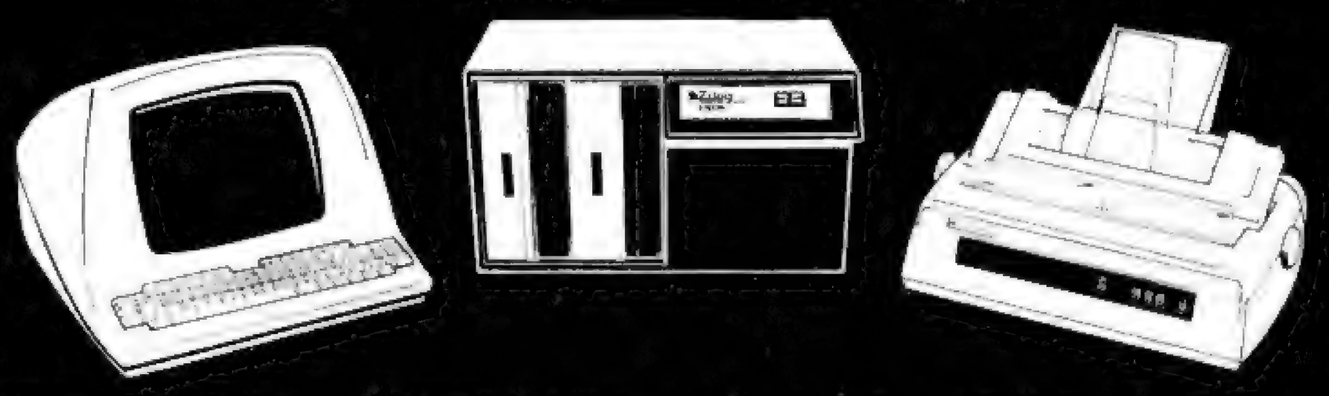
The British Library has completed some work on the development of its own retrieval software to run on an ICL computer. However because of financial problems the project entitled MERLIN has been shelved.

The BLAISE service is operated on a commercial basis and is widely used by libraries in the United Kingdom and Europe. Many libraries including some public libraries offer access to BLAISE and the American services such as Lockheed DIALOG and ORBIT. The charging policies vary but the tendency is to charge £1 per connect minute. The average time per search is no more than 15 minutes, so the comment that it may be cheaper to fly to Washington and back than to use a commercial database is very far from the truth.

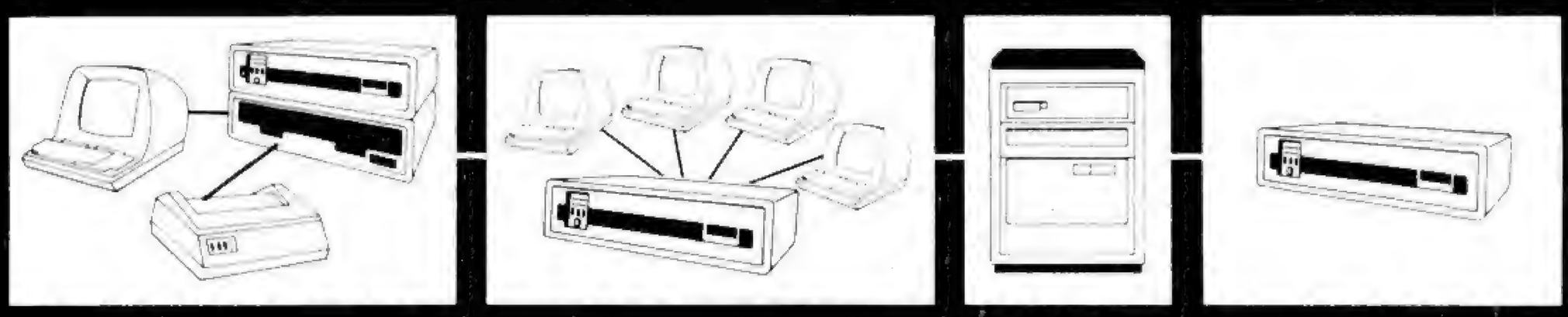
There is no doubt that the United States of America is at the Vanguard of the online information retrieval area. However, to dismiss the efforts of the British Library in the way Mr Sutcliffe has done is to ignore the realities of the situation.
Robin Frederick Guy, Aberystwyth



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BENCH TEST

SHARP PC-3201



Lyn Antill puts another Japanese newcomer through its paces.

After the successful launch of the MZ-80K personal microcomputer, Sharp has now launched an attack on the small business computer market with the PC-3201. The machine has been specially geared to the business market rather than trying to make a machine which offers something for everyone. This approach is quite the opposite of that adopted by Transam for the Tuscan, which I reviewed a few months ago. In fact, Sharp was rather concerned to hear that we tested machines for speed in performing calculations and loops, making the point that speed was not so important as accuracy and so had used binary coded decimal format for the arithmetic in order to get more significant figures than were possible with the normal Z80 arithmetic.

The Benchtest machine was provided complete with peripherals and with a range of business software that Sharp had commissioned from Padmede especially for the PC-3201. The aim is to produce a reliable, business-like machine with the level of software and support that the non-computing businessman would value.

Hardware

The system arrived in four boxes, all of which could be carried comfortably. This only matters if you are in the habit of carrying your computer around — but then I am, and mine's heavy! The four components are the computer with built-in keyboard, the VDU, the disk drives and the printer. To complete Sharp's 'support the user' image, the salesman also delivered a dust cover and a four-way extension to plug all the units into.

All the units are in shiny grey plastic and have a sleek professional look to them. However, John Cleese might be able to point to the 'platefuls of spaghetti' at the back. The main box measures 18in x 14in x 4in at its deepest and the PCBs are specially designed to fit in.

The VDU is particularly nice because it comes on a swivel so that you can adjust the screen up or down and then fix it at the required angle. It sits on a base plate which fits under the computer/keyboard unit and which permits a bit more adjustment of the actual position of the screen, yet the whole thing still looks like one unit rather than a box with a TV on top. The colours used are green on black and there is a separate brightness control. The 12in screen can have 80 by 25 chs including a wide range of graphics, or it can be run with 40 by 12 double-size characters.

The standard qwerty keyboard has a good feel to it. The cursor control keys are located at the top right of the letter pad and there is a separate numeric pad. Ten function keys are provided for user definition as well as some predefined keys such as RUN and HALT. One additional switch on the keyboard transfers the machine between programming and operational mode. When this is set to OP, only program execution and manual operation are permitted.

The Benchtest machine had twin 5in floppy drives, although it is apparently possible to use as many as eight disk drives, four each on two separate channels. I can't imagine wanting to juggle eight sets of floppy disks! An Epson printer was used. This is capable of bidirectional printing and doing a good range of graphics characters which Padmede uses to good effect in creating the printouts on the commercial software.

The PC-3201 is built around a Z80 microprocessor. It has 32 kbytes of ROM and 64 kbytes of RAM which can be extended up to a maximum of 112 kbytes. The video display is memory-mapped into RAM and the keyboard can be used to generate graphics characters in much the same way as on a PET, except that the graphic symbol associated with each key is not shown on the keyboard but on a separate chart. There are 44 of these altogether. Quite a few keys can be used in conjunction with the command key 'CMD' to serve as abbreviations when entering commands, eg, 'CMD' '1' is equivalent to 'DISP'. This can be time-saving for the programmer, although I doubt if the casual user would remember them.

There is even a three-octave music function so that you can write melodies by specifying the tempo and the pitch and duration of each note. One of the programs I tried out did a convincing version of 'uh! uh!' every time you made a mistake.

Software

FDOS is the operating system used and the only language available is a very extended version of Basic. Although FDOS does claim to be capable of supporting other languages, none was actually mentioned.

The manual tells you very little about FDOS except that it is used for handling disk Basic files. Again Sharp is working on the assumption that it is dealing with users rather than hobbyists or programmers. The FDOS commands available are: Basic, Init, Cat (to list the files on a disk), Backup (to create a copy of a whole disk, protection levels and all), Copy (for individual files), Killall (to clear a disk), and Debug. Init seems to be very slow, although I was assured that it does verify each track as it initialises it.

Two manuals come with the system; one covers the computer and the other deals with the disk-based operations. Both are pretty well full of Basic instructions. Indeed, it's the largest Basic I've ever used, with about 100 instructions. There are all the usual ones plus a whole lot of others, mostly to use the special features of the machine such as Music and the function keys, which can be turned on and off at various points in the program. There are also a whole lot of display statements to make use of the extensive screen facilities. The cursor can be moved to any character position on the screen with the CURSOR instruction, while MVCUR moves the cursor on so many from its previous position. The screen can also be treated as a 160x50 array of points of light, each one of which can be set on or off by SET X,Y or RESET X,Y. The POS A,B instruction will return the position of the cursor at the time. It is possible to set fields into reverse video or make them blink and there is a COLOR instruction for machines with a colour monitor.

There is one very natty screen instruction — TABLE. This permits you to give a list of column and row sizes and it will then create a lattice of horizontal and vertical lines. This is extremely useful for input, as much of the information which a businessman wants to put into his micro comes in precisely that tabular form — invoices, stock records, etc. You even get a choice of whether the lines around the table should be set straight or made up of fancy characters like asterisks.

The display instructions and those for trapping function keys might seem like fancy frills, as the normal Basic instructions could be used to handle them; but human beings are the most expensive part of any computer system and anything which can regularly save lines of code throughout a program is of great commercial value, especially where it also permits programs to be written in such a way that they are quick and easy to operate.

Another factor which leads to efficiency in programming is the use of libraries of subprograms to do routine jobs. These subprograms need to be callable from the main program. This is done by a simple LOAD SUB command which adds the subprogram into memory with the main program. There is also a CHAIN command which calls the next program from a program which has finished, so that several programs may be executed in a predetermined sequence.

An ALOAD command causes a predetermined program to be called in and executed as soon as the program has been switched on. This is an extremely useful feature for the commercial user because it means that the operator has only to load the FDOS master disk with the required program on it and then simply switch on.

Video display can be stored in RAM and called up when required with VSAVE and VLOAD. KSAVE and KLOAD will do the same for definitions of definable keys. Both of these are very useful for simplifying and standardising the use of the screen and of the function keys.

As expected, the Benchmark times were very slow. It also took 70 seconds to auto-load a program from switching the machine on to being ready to load the data disks. This sort of delay is irritating when you are swapping from one program to another, but would be trivial if the same program was to be run for a long stretch. In fact, auto-loading in this way is actually quicker than loading a system disk, then a program disk, and then typing the name of the program to be executed. However, a much more significant point was the accuracy with which calculations can be done. To test this, I took the exchange rate calculations with which I am familiar and tried them on the Sharp and on my Tuscan (which doesn't have double precision) and compared the results: $1,250,000.00 at 2.232 gave an answer correct to .01 of a penny on the Sharp, whereas my Tuscan only gave the answer as a whole number of pounds, £2 out, and was quite incapable of dealing with the pennies. So, if you want to get correct answers to calculations involving more than £1000 (and most businessmen do) then you will probably agree with Sharp in putting accuracy before speed.

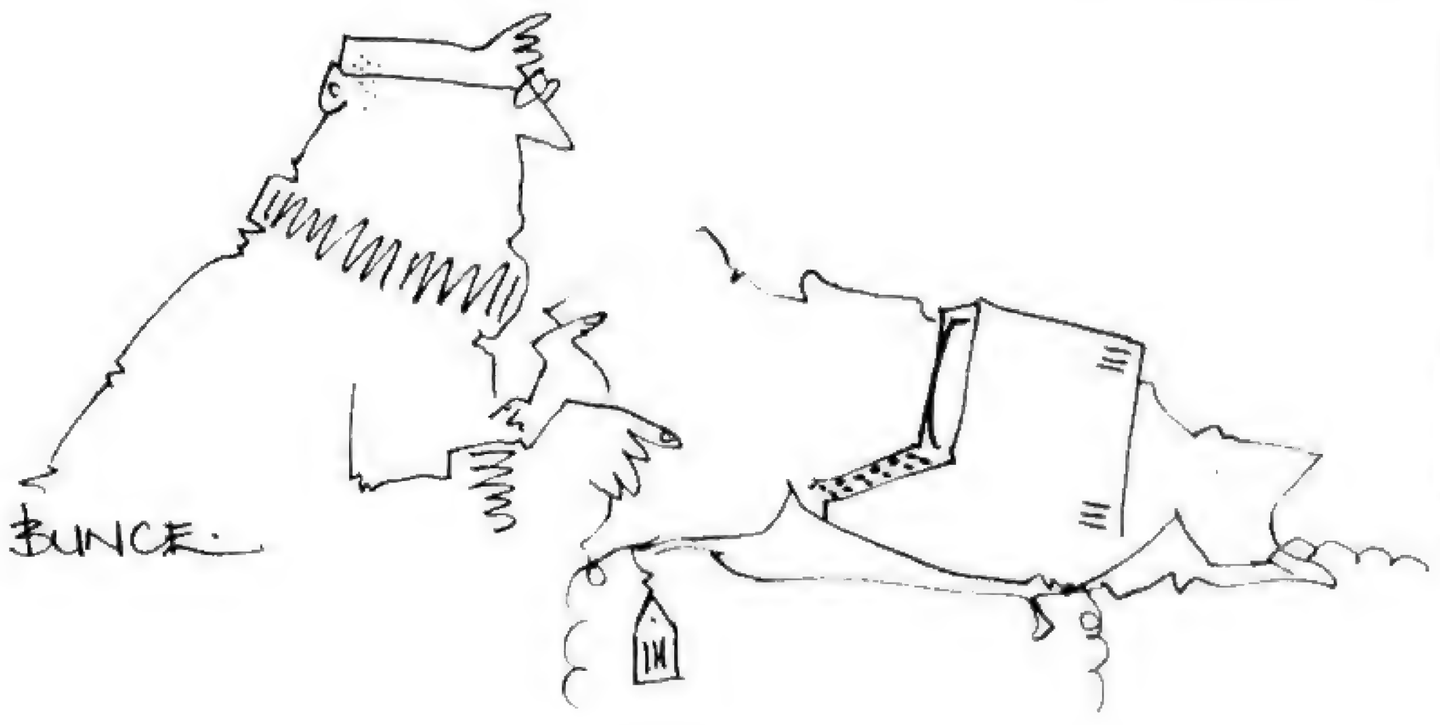
Commercial programs

The business software which Sharp commissioned from Padmede Computer Services consists of Sales Ledger, Purchase Ledger, Sales Invoicing and Nominal Ledger. The versions provided for the Benchtest were the demonstration ones used by dealers. These were primarily used to show what the PC-3201 was capable of doing, rather than to Benchtest the software itself.

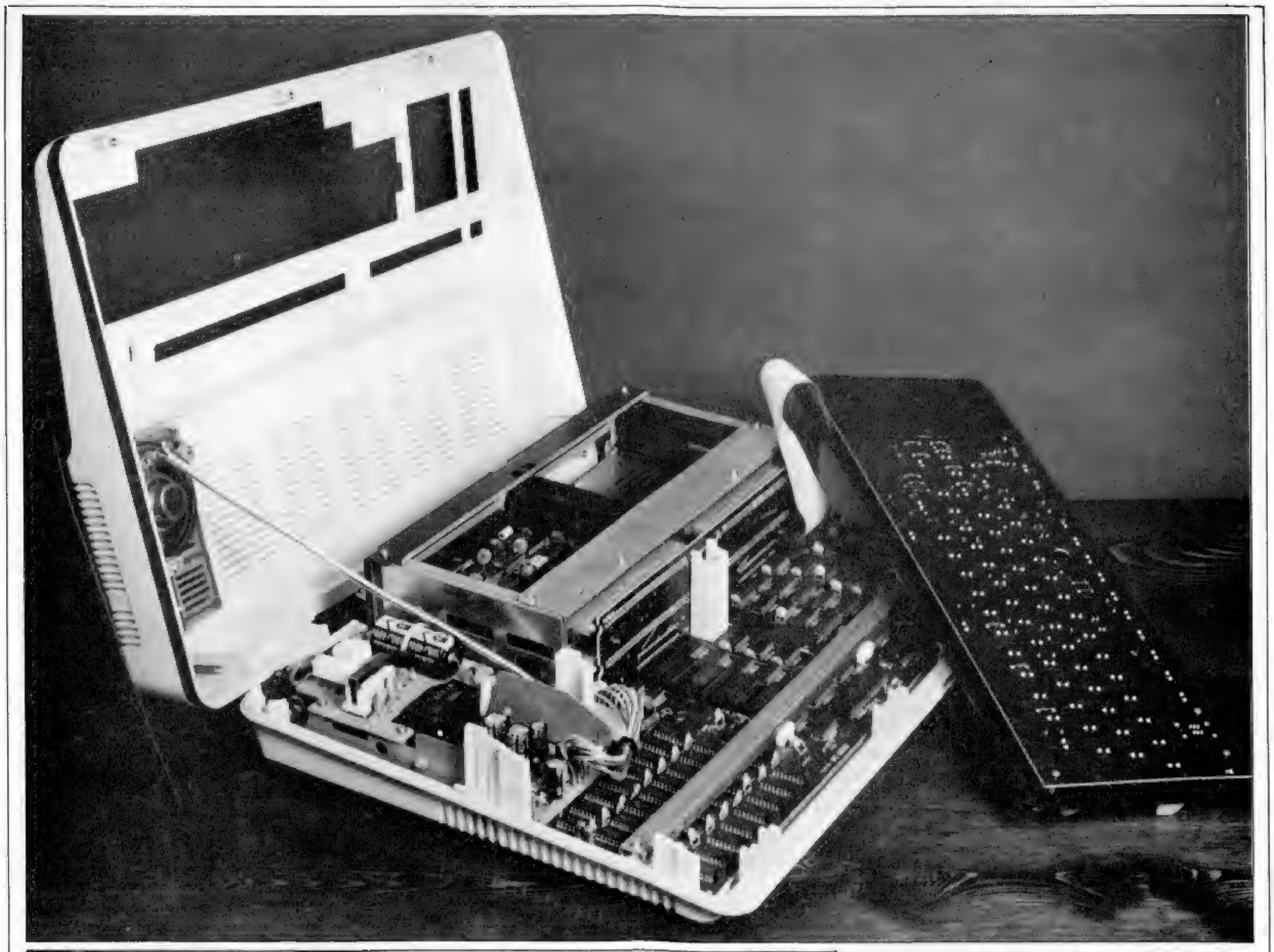
Fourteen seconds after switch-on, a large video display announced that the program is loading. The programs work on the menu principle, and make good use of the excellent graphics facilities. They are self-explanatory and easy to use and certainly appear to be doing the right sorts of things, although I wasn't able to test the difficult bits, such as security and backup. My accountant was a little puzzled by some of the VAT calculations but was able to get the right answers in the end.

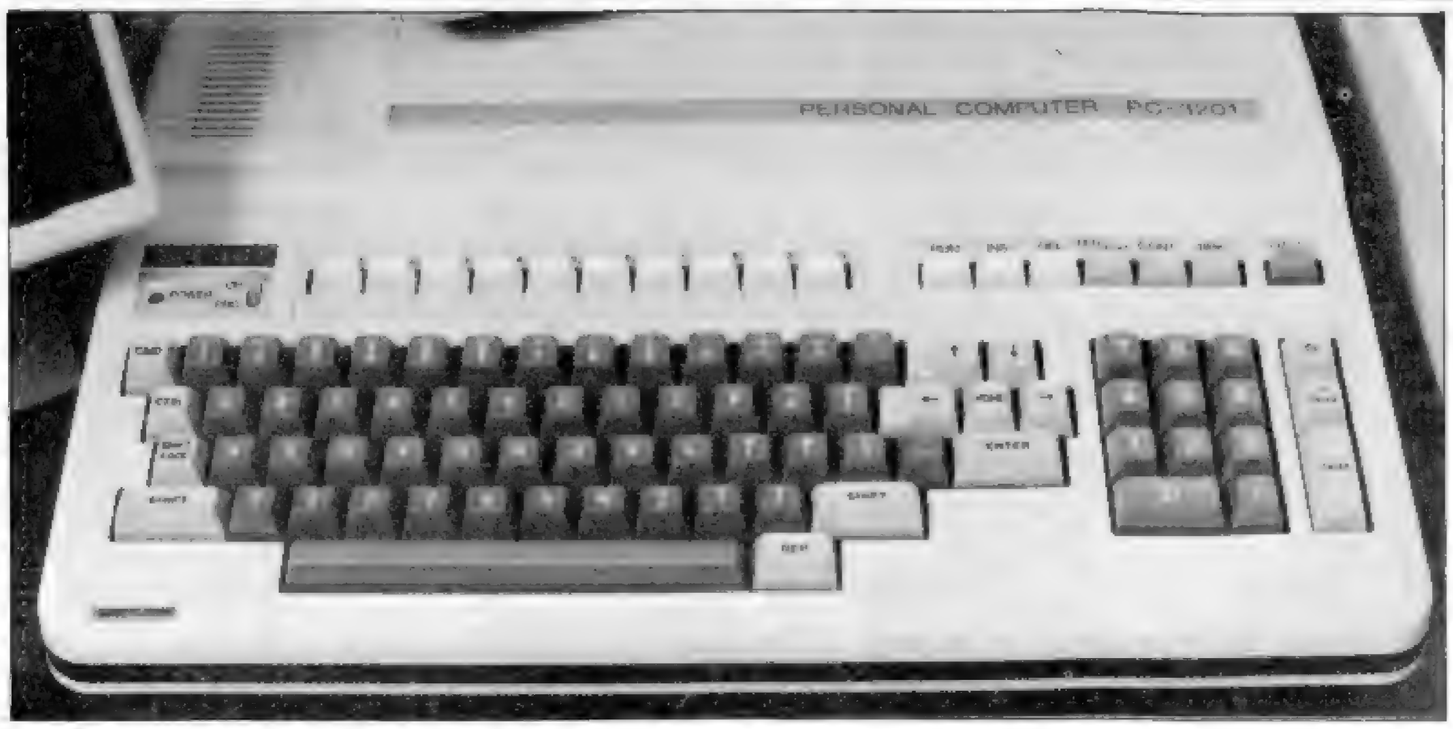
The slowness of operation is not really apparent, except when loading, and is certainly not a problem, because the speed of running a commercial program usually depends on the speed of keying. If you have a heavy workload and still want a good-looking machine with a good service reputation and the same facilities as the Sharp, then you must reconcile yourself to paying more for the extra speed.

I have a 'thing' about documentation and I was a little disappointed by the manuals that go with the Padmede programs — I would have liked a bit more help in using them. But they did include plenty of examples, which is always helpful.



'It took you precisely eight minutes 47.09 seconds to open this parcel — you certainly do need me!'





Inside and outside the PC-3201.

Support

The commercial user is much more concerned about this than the hobbyist or even the educational user. If the machine that produces your invoices goes down, you don't send any invoices and you don't get any money. Sharp is aware of this and is trying to restrict dealerships to those capable of doing the sort of hand-holding and backup the users need. So far Sharp has only authorised 50 suppliers.

Conclusion

Don't buy this machine if you want fast processing, or lots of languages, but if you are a commercial user wanting to do straightforward jobs accurately and stylishly then the PC-3201 is well worth considering. The minimum configuration of 64k processor, twin 5in double-sided, double-density floppies, printer and 12in screen costs just under £3000, which certainly represents good value.

At a glance

This is a good-looking, apparently reliable and well-supported business computer with a very extended Basic, good graphics (and music!) and a range of standard business programs. The minimum configuration costs £3000. The keyboard is excellent and so is the adjustable screen, except that there are no true descenders.

Drawbacks are that it only supports Basic, and that it is extremely slow. It is already a good, reliable business machine, and if Sharp's software experts can speed it up and provide a wider range of languages and applications, it could be super.

Benchmark timings (in seconds)

1	4
2	13.5
3	35.5
4	35.5
5	38.5
6	67
7	108
8	25

Reading 100 random records: 70
Writing 100 random records: 70

Hardware prices

PC-3201	64k CPU	£1500
CE 320C	80 x 25 CRT	£250
CE 332P	Dot matrix printer	£450
CE 331M	Twin disk unit	£670
CE 341M	Floppy interface card	£125
CE 350L	Additional cable	£30

Software prices

Sales Ledger	£300
Purchase Ledger	£300
Invoicing System	£300
Nominal Ledger	£450

Compiled by Kevin O'Connell

BELLE, BELLER, BELLEST

I find it hard to accept that Belle, the World Computer Chess Champion, is a micro. However, Belle's principal creator, Dr Ken Thompson of Bell Labs (and Unix fame), argued tenaciously that it might reasonably be considered to be so. This raises some important questions on which I would like to hear your views; for the purpose of a chess tournament, what *is* a micro? However, for the sake of argument and so that I can tell you something about the World Computer Champion in this column, let's accept Dr Thompson's argument.

Those who attended the recent conference on Advances in Computer Chess at Imperial College heard Dr Thompson talk about his chess machine. Since most of you were not present, here are some of the details which he revealed.

Belle is now in its (her?) third generation. The original Belle was a small piece of special hardware which was a good enough player to finish equal fourth in the World Computer Championship in Toronto in 1977. Finishing 1½ points behind the winner (Chess 4.6) in a four-round tournament seems to have acted as a spur to Dr Thompson.

The second incarnation of Belle followed about a year after the Toronto tournament and again took the form of special chess hardware (LSI/11, move generator, move evaluator and associated memory). This hardware, with 256k main memory and 1 Mbyte of 'associated memory' (used for storing a look-up table of about 100k chess positions) performed quite well and achieved a respectable rating of 1900 on the World Chess Federation scale.

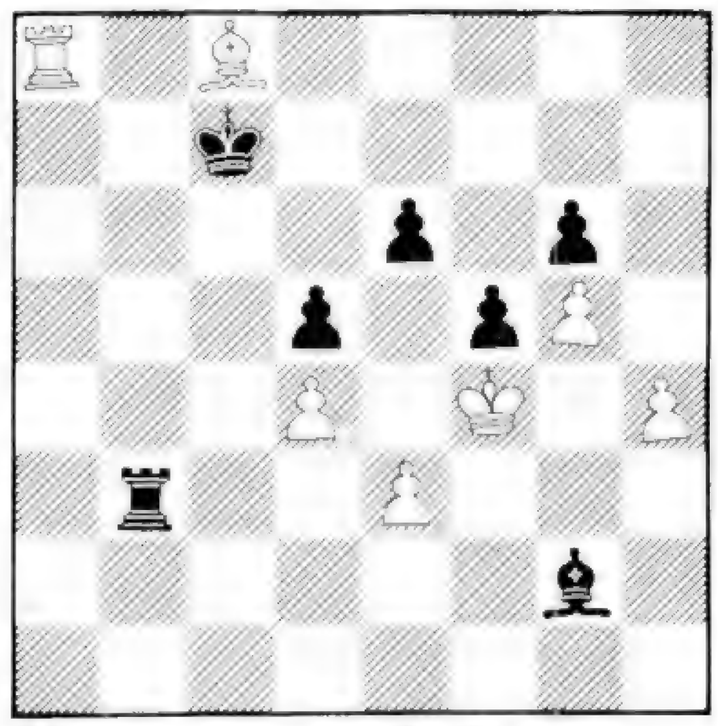
It is, though, the third machine, which adds a PDP-11 and a 35 Mbyte Winchester (used principally for the openings book of 300k positions) to the special hardware, that has attained formidable strength and which won the World Championship in Linz last year. The rough chronology of its development during 1980 was: February — basic design; May — finalisation of design; June — construction; July — development; 20 July — the machine made its first half-move; at the beginning of August it played its first game, losing to the old Belle program; 6 August — it beat the old program convincingly; 8 August — first games played against a human opponent, winning two games of '30-30' (each player has 30 minutes' thinking time to make 30 moves) against a master strength player; late August — played its first tournament in preparation for Linz; September — program still being debugged and it played its second tournament since when the program has not changed significantly (erasing and blowing 256 PROMs is something of a deterrent to fixing even major bugs).

At the end of last September, Belle tied for first place in the World Computer Championship in Linz and then won the play-off match against 'Chaos'. Since then, Belle has had a series of considerable successes, including scoring 1½ out of 2 in 30-30 games against the internationally known US master Mike Valvo and taking second place in a human master tournament (albeit a very weak one). Belle's current rating on the world scale is 140, but its performances in the last year have been running at about 2320 — and that is better than several of the world's 300 or so active International Masters.

That is an amazing achievement for a pure brute force program, even analysing 160,000 nodes per second. No less amazing is the following game played on 9 August last year, less than a week after the program started playing. The West German Grandmaster Helmut Pfleger (one of the 100 or so best players in the world) was given a simultaneous display against 26 opponents, apparently all humans, for German TV. It turned out, however, that one of the humans was relaying moves to and from a telephone line to Bell Labs in New Jersey.

White: Helmut Pfleger (rating 2525)
Black: Belle (rating 1900)

1.	d2–d4	d7–d5
2.	c2–c4	c7–c6
3.	c4xd5	c6xd5
4.	Nb1–c3	Nb8–c6
5.	Ng1–f3	Ng8–f6
6.	Bc1–f4	Bc8–f5
7.	e2–e3	e7–e6
8.	Bf1–b5	Nf6–d7
9.	0–0(Ke1–g1)	Bf8–e7
10.	Qd1–e2	Ra8–c8
11.	Ra1–c1	Bf5–g4
12.	h2–h3	Bg4–h5
13.	g2–g4	Bh5–g6
14.	Nf3–e5	Nd7xe5
15.	Bf4xe5	0–0(Ke8–g8)
16.	Be5–g3	f7–f5
17.	Bb5–d3	Be7–d6
18.	f2–f4	Bd6–b4
19.	g4–g5	Qd8–e8
20.	a2–a3	Bg6–h5
21.	Qe2–d2	Bb4–a5
22.	b2–b4	Ba5–b6
23.	Kg1–h2	Rf8–f7
24.	Nc3–b5	Rf7–d7
25.	a3–a4	a7–a5
26.	b4xa5	Bb6xa5
27.	Qd2–b2	Ba5–b4
28.	Bg3–e1	Bb4xe1
29.	Rf1xe1	Qe8–d8
30.	Qb2–a3	Bh5–f3
31.	Kh2–g3	Bf3–h5
32.	Rc1–c2	Qd8–a5
33.	Re1–c1	Rc8–a8
34.	Nb5–d6	Qa5xa4
35.	Qa3xa4	Ra8xa4
36.	Nd6xb7	Rd7xb7
37.	Rc2xc6	Ra4–a3
38.	Rc1–c3	Ra3xc3
39.	Rc6xc3	h7–h6
40.	h3–h4	Kg8–f8
41.	Bd3–a6	Rb7–b6
42.	Ba6–f1	h6xg5
43.	f4xg5	g7–g6
44.	Kg3–f4	Kf8–e7
45.	Kf4–e5	Bh5–f3
46.	Rc3–c7+	Ke7–d8
47.	Rc7–g7	Bf3–h5
48.	Rg7–a7	Bh5–f3
49.	Bf1–a6	Bf3–g2
50.	Ra7–a8+	Kd8–c7
51.	Ba6–c8	Rb6–b3
52.	Ke5–f4	



52.	. . .	e6–e5+
53.	Kf4xe5	Rb3xe3+
54.	Ke5–f6	f5–f4
55.	Bc8–e6	Kc7–b6
56.	h4–h5	g6xh5
57.	g5–g6	f4–f3
58.	Be6xd5	Bg2–h1
59.	Ra8–a1	f3–f2
60.	Ra1–b1+	Kb6–c7
61.	Bd5xh1	Re3–e1
62.	Bh1–g2	Re1xb1
63.	g6–g7	Rb1–g1
64.	g7–g8Q	f2–f1Q+
65.	Bg2xf1	Rg1xg8
66.	Bf1–h3	Kc7–d6
67.	d4–d5	h5–h4
68.	Bh3–e6	Rg8–g3

White resigns.

Whether or not Belle should be counted as a micro, the micro chess machines are making great progress. One of the mini-micros that I am associated with, the Chess Champion Mk V, played a couple of games against the second-generation Belle during the computer conference, winning one and drawing one, which establishes that at about 1900, and the new Morphy machine from ACI is close behind — Danny Kopec, another speaker at the conference, assessed its rating at about 1850.

The 2nd European Microcomputer Chess Championship

Don't forget — the Second European Microcomputer Chess Championship

GOTO page 157

Make the most of your Sinclair ZX Computer...

Sinclair ZX software on cassette.

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The unprecedented popularity of the ZX Series of Sinclair Personal Computers has generated a large volume of programs written by users.

Sinclair has undertaken to publish the most elegant of these on pre-recorded cassettes. Each program is carefully vetted for interest and quality, and then grouped with other programs to form a single-subject cassette.

Each cassette costs £3.95 (including VAT and p&p) and comes complete with full instructions.

Although primarily designed for the Sinclair ZX81, many of the cassettes are suitable for running on a Sinclair ZX80 – if fitted with a replacement 8K BASIC ROM.

Some of the more elaborate programs can be run only on a Sinclair ZX Personal Computer augmented by a 16K-byte add-on RAM pack.

This RAM pack and the replacement ROM are described below. And the description of each cassette makes it clear what hardware is required.

8K BASIC ROM

The 8K BASIC ROM used in the ZX81 is available to ZX80 owners as a drop-in replacement chip. With the exception of animated graphics, all the advanced features of the ZX81 are now available on a ZX80 – including the ability to run much of the Sinclair ZX Software.

The ROM chip comes with a new keyboard template, which can be overlaid on the existing keyboard in minutes, and a new operating manual.

16K-BYTE RAM pack

The 16K-byte RAM pack provides 16-times more memory in one complete module. Compatible with the ZX81 *and* the ZX80, it can be used for program storage or as a database.

The RAM pack simply plugs into the existing expansion port on the rear of a Sinclair ZX Personal Computer.



Cassette 1 – Games

For ZX81 (and ZX80 with 8K BASIC ROM)

ORBIT – your space craft's mission is to pick up a very valuable cargo that's in orbit around a star.

SNIPER – you're surrounded by 40 of the enemy. How quickly can you spot and shoot them when they appear?

METEORS – your starship is cruising through space when you meet a meteor storm. How long can you dodge the deadly danger?

LIFE – J.H. Conway's 'Game of Life' has achieved tremendous popularity in the computing world. Study the life, death and evolution patterns of cells.

WOLFPACK – your naval destroyer is on a submarine hunt. The depth charges are armed, but must be fired with precision.

GOLF – what's your handicap? It's a tricky course but you control the strength of your shots.

Cassette 2 – Junior Education: 7-11-year-olds

For ZX81 with 16K RAM pack

CRASH – simple addition – with the added attraction of a car crash if you get it wrong.

MULTIPLY – long multiplication with five levels of difficulty. If the answer's wrong – the solution is explained.

TRAIN – multiplication tests against the computer. The winner's train reaches the station first.

FRACTIONS – fractions explained at three levels of difficulty. A ten-question test completes the program.

ADDSUB – addition and subtraction with three levels of difficulty. Again, wrong answers are followed by an explanation.

DIVISION – with five levels of difficulty. Mistakes are explained graphically, and a running score is displayed.

SPELLING – up to 500 words over five levels of difficulty. You can even change the words yourself.

Cassette 3 – Business and Household

For ZX81 (and ZX80 with 8K BASIC ROM) with 16K RAM pack

TELEPHONE – set up your own computerised telephone directory and address book. Changes, additions and deletions of up to 50 entries are easy.

NOTE PAD – a powerful, easy-to-run system for storing and retrieving everyday information. Use it as a diary, a catalogue, a reminder system, or a directory.

BANK ACCOUNT – a sophisticated financial recording system with comprehensive documentation. Use it at home to keep track of 'where the money goes,' and at work for expenses, departmental budgets, etc.

Cassette 4 – Games

For ZX81 (and ZX80 with 8K BASIC ROM) and 16K RAM pack

LUNAR LANDING – bring the lunar module down from orbit to a soft landing. You control attitude and orbital direction – but watch the fuel gauge! The screen displays your flight status – digitally and graphically.

TWENTYONE – a dice version of Blackjack.

COMBAT – you're on a suicide space mission. You have only 12 missiles but the aliens have unlimited strength. Can you take 12 of them with you?

SUBSTRIKE – on patrol, your frigate detects a pack of 10 enemy subs. Can you depth-charge them before they torpedo you?

CODEBREAKER – the computer thinks of a 4-digit number which you have to guess in up to 10 tries. The logical approach is best!

MAYDAY – in answer to a distress call, you've narrowed down the search area to 343 cubic kilometers of deep space. Can you find the astronaut before his life-support system fails in 10 hours time?

Cassette 5 – Junior Education: 9-11-year-olds

For ZX81 (and ZX80 with 8K BASIC ROM)

MATHS – tests arithmetic with three levels of difficulty, and gives your score out of 10.

BALANCE – tests understanding of levers/fulcrum theory with a series of graphic examples.

VOLUMES – 'yes' or 'no' answers from the computer to a series of cube volume calculations.

AVERAGES – what's the average height of your class? The average shoe size of your family? The average pocket money of your friends? The computer plots a bar chart, and distinguishes MEAN from MEDIAN.

BASES – convert from decimal (base 10) to other bases of your choice in the range 2 to 9.

TEMP – Volumes, temperatures – and their combinations.

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COMPUTER GAMES

SHOGI

David Levy looks East for this month's game.



This month I wish to introduce readers to a game which they will almost certainly never have come across. It is related to chess, but has an added dimension of complexity which can result in exciting sequences being sustained for very many more moves than in chess. This game is so popular in its country of origin (there are some 19 million players) that those who excel at the game often become millionaires, and are held in greater esteem than Bjorn Borg in Sweden or Kevin Keegan in England. I am referring to shogi, or Japanese chess, and I can recommend the game very highly to anyone who enjoys 'western' chess. My shogi-playing friends have been trying to persuade me for some time that 'western' chess is an inferior form of the game and, although I have yet to be firmly convinced by their arguments, I must confess that shogi does have enormous appeal. Since it is well known that computer programmers usually show great aptitude for chess, it is likely that among the readers of this magazine there are many potential shogi masters (or dans as they are known in Japan), and many thousands who would enjoy the game if they took an hour or so to learn how to play it.

Japan is the Mecca of shogi, but during the past few years an organisation has grown up in the western world whose aim is to popularise the game outside its native country. The Shogi Association, PO Box 77, Bromley, Kent, England welcomes new members and will supply shogi sets and elementary literature to those who cannot find them elsewhere. It also publishes a regular magazine and holds meetings in London. Through the efforts of the Shogi Association there have been shogi tournaments held in London, for which leading Japanese players have flown half way round the globe, and in last year's tournament I was able to see my colleague Larry Kaufman, an International Chess Master from the USA who seems to have abandoned the 'inferior' form of the game for its Japanese counterpart. I understand that he has now become completely addicted, to the extent of travelling to Japan in the hope of becoming a professional shogi player.

How to play Shogi

The best way to learn the game of shogi is to buy a copy of *How to Play Shogi* by John Fairbairn, and to study this slim volume with a shogi set in front of you. Although shogi sets normally have the pieces inscribed in Japanese characters, the Shogi Association imports sets in which the pieces also have westernised lettering as well as arrows to show you how each of them moves. It should take no longer to learn the moves at shogi than to learn how to play western chess, and I am reliably informed that one can even get used to the Japanese symbols rather more quickly than one might suspect. Since the main point of this article is to enable the reader to write his own shogi-playing program, I must begin with a precis of the rules and moves of the game.

Each player starts the game with 20 pieces made of wood or plastic. These pieces are uniform in colour, but for the sake of convenience we call them Black and White, as in chess. The game is played on a 9 x 9 board (does anyone know of a 9-bit processor?) with the two armies set up in the following starting position:

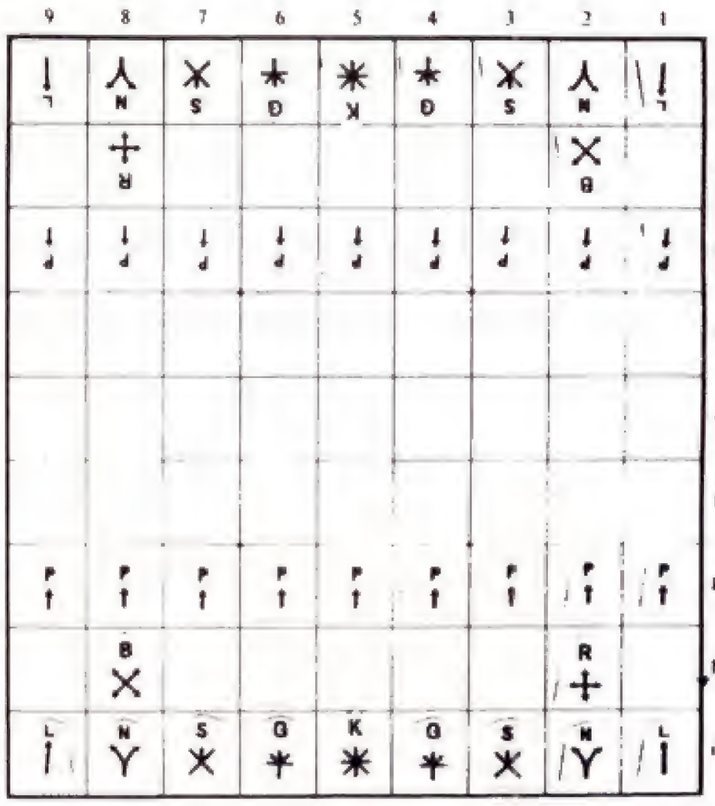


Fig 1 The starting position in shogi.

The pieces and their moves

KING: Each player has one king and, as in chess, the object of the game is to checkmate the opposing king. As in chess the king can move one square in any direction (horizontal, vertical or diagonal).
GOLD GENERAL: At the start of a game each player has two golds. The gold moves one square at a time, vertically, horizontally, or diagonally forwards. It may not move diagonally backwards.
SILVER GENERAL: Each player has two silvers. The silver moves one square at a time, diagonally or forwards. It may not move sideways and it may not move straight backwards.
KNIGHT: Each player has two knights, whose move has the same form as the knight in chess but with the restriction that it may only move two squares forwards and then one square to the left or right. So whereas a chess knight has eight moves at its disposal from a central square on an empty board, a shogi knight will have only two possible moves, but as in chess it may jump.
LANCE: Each of the two lances moves straight forwards as far as it likes, but it may not jump.
ROOK: The shogi rook moves exactly like its counterpart in western chess, in a straight line as many squares as it wishes. There is no queen in shogi, so the rook is usually regarded as the most powerful piece.
BISHOP: Again this piece moves just like a chess bishop — any number of squares in a diagonal direction.
PAWN: As in chess, the initial shogi position has a row of pawns across the board. Since shogi is played on a 9 x 9 board, each player begins the game with nine pawns, which can move one square forwards. There is no double pawn move when a pawn makes its first move; there is no diagonal capturing move; and there is no such thing as an en passant capture.

Promoted pieces

One of the most interesting aspects of shogi, as compared to chess, is the fact that whereas in chess only the pawns can promote to a piece of higher value, in shogi some of the other pieces can also promote. A promotion move is made by moving a piece partly or wholly within your promotion zone (the last three ranks or rows furthest from you). Promotion takes place at the conclusion of the promoting move, and it is important to remember that in shogi it is not always compulsory to promote, as we shall see. The following pieces have the ability to promote:
SILVER: The promoted silver moves exactly like a gold. On your shogi set the silver can be turned over and on the reverse side you will see the symbol for a promoted silver.
KNIGHT: The promoted knight also moves exactly like a gold.
LANCE: The promoted lance moves exactly like a gold.
PAWN: The promoted pawn moves exactly like a gold.
ROOK: When the rook is promoted it retains its original ability to move any number of squares horizontally or vertically, and acquires the extra ability to move one square in a diagonal direction.
BISHOP: Similarly, when the bishop is promoted, its original move is retained and it has the new ability to move one square vertically or horizontally.

If a pawn or lance moves to the last rank, or if a knight moves to either of the last two ranks, promotion is compulsory. At all other times, promotion is optional.

Capturing

If a player moves one of his pieces onto a square that is occupied by one of his opponent's men, the opponent's piece is captured as in chess. But here lies one essential difference between the two games, and it is this difference that adds an extra dimension to the game of shogi.

In chess, when you capture one of your opponent's pieces it is removed from the board forever. In shogi you keep this piece 'in hand', and later in the game you may drop it onto any vacant square (subject to a few restrictions). The drop is made instead of moving a piece from one square to another, and it is important to remember that a piece may only be dropped in its unpromoted state, even if it had been promoted before it was captured. When you drop a captured piece onto the board it becomes your own piece, and for this reason the capture of an enemy piece has a double significance. One interesting aspect of the drop is the fact that you might well decide to sacrifice a valuable piece on one part of the board in return for an inferior one, simply because you want to be able to drop that inferior piece on another part of the board within the next few moves.

Check and checkmate

When a king is attacked it is said to be in check, just as in chess, and the player who is in check must take evasive action immediately — moving his own king, capturing the checking piece, or interposing a piece between the two. If the king is attacked and there is no way to save it, the player has been checkmated. Since all of the pieces are, in practical terms, in play throughout the game, it is extremely rare for a game of shogi to end in a draw. In chess the number of the pieces on the board is gradually reduced as the game progresses, and when sufficient reduction has taken place the game will inevitably end in a draw. Those who find master chess games boring because too many of them (some 55 percent or more) are drawn, need have no such fear regarding shogi.

How to program Shogi

There is no reason why most of the principles that apply to chess programming cannot also be applied to shogi programming. Growing and searching a game tree is the obvious approach, the most serious problem being the large branching factor caused by the increased number of pieces (40 instead of a maximum of 32) and the possibility of the drop. If you hold just one type of captured piece 'in hand' you will have 42 or more squares on which it may be dropped. It is easy to see how the number of legal moves at one's disposal can easily increase to 150 or 200, once two or three enemy pieces have been captured. Clearly it is necessary to find some way of reducing the list of legal moves to produce a list of plausible moves which is of manageable size. The answer to this problem lies in the use of intelligent shogi heuristics, or 'proverbs' as they are known in the trade.

Anyone who is interested in writing a chess program need only refer to the enormous wealth of chess literature in order to find a number of heuristics which can be employed in a plausible move generator or an evaluation mechanism. A lot has also been written about shogi, but unfortunately for most readers of this article it is almost entirely published in Japanese, and if your Japanese is anywhere near as bad as mine is you will not relish the thought of ploughing through tomes of mysterious symbols. Here I have space for only a very small number of heuristics, and I must recommend the reader to take a look at the extensive list which can be found at the back of Fairbairn's booklet. In addition, those of you who would like to make your shogi programs as strong as possible ought to join the Shogi Association and try to obtain all the back numbers of *Shogi* magazine *(issue 1 is sold out — Ed.)*, in which the most important proverbs are explained. Once you understand a proverb, it is an easy matter to convert it to numerical form so that it can form part of the evaluation/plausibility mechanism.

Shogi openings

The exact order in which the opening moves are played does not appear to be so critical in shogi as it is in chess. The most important aspect of opening play in shogi seems to be the squares on which one places one's pieces, and not the exact order in which they are moved there. The only source of shogi openings that I can find in any language other than Japanese is, once again, that published by the Shogi Association.

Since it is not necessary for your shogi program to have access to large tables of opening variations, you need only devise some method of encouraging the program to make moves that will lead to its pieces being on the right squares. A simple method of accomplishing this is to examine each of the pieces in a desired formation and determine how many moves away from its target square it is at the moment. The 'opening' feature in the evaluation function can then be penalised by (say) 1 point for each piece that is one move away from its target square, 2 points for each piece that is two moves away, and so on. This method, or any similar pattern-matching process, will provide a useful measure as to the degree to which a desired opening formation has been achieved.

The middle game– a few heuristics

As in chess, the middle game in shogi sees most of the manoeuvring and

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This Nasbus compatible EPROM board accepts up to 16, 2716 or 2708 EPROMs
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The Castle interface is a built and tested add-on unit which lifts the Nascom-2 into the class of the fully professional computer. It mutes spurious output from cassette recorder switching, adds motor control facilities, automatically switches output between cassette and printer, simplifies 2400 baud cassette operating and provides true RS232 handshake.

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For Nascom ROM BASIC running under Nas-Sys. Supplied in 2 x 2708 EPROMs. Features include: auto line numbering; intelligent renumbering; program appending; line deletion; hexadecimal conversion; recompression of reserved words; auto repeat; and printer handshake routines. When ordering please state whether this is to be used with Nas-Sys 1 or 3. **Price £28 + VAT.**

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All prices are correct at time of going to press and are effective 1st June 1981.

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struggling for a strategic advantage. This is the part of the game for which an evaluation function will be of the greatest use. The players must fight for control of important squares, and in particular for control of the area near their opponent's king. In shogi the initiative is just as important as it is in chess, and by building up a strong attack in the area near the enemy king, a player may develop an initiative which can later be converted into a win. Many of the heuristics that you will find in *Shogi* magazine will relate to the initiative and to the concepts of king attack and king safety.

Perhaps the most difficult problem that you will encounter when writing a shogi program is that nobody has written one before you, so there is absolutely no published literature on the subject. In order to convert a shogi heuristic into a feature for your evaluation function you will therefore be compelled to make various guesses and estimates, and then improve the weightings of your function in the light of experience.

Possibly the most surprising aspect of shogi heuristics is the fact that there is no recognised scale of values for the pieces themselves. Almost every schoolboy knows that in chess a bishop or knight is worth roughly three pawns, a rook five pawns, and a queen nine pawns, but to the best of my knowledge there is nothing reliable in the shogi literature to compare. (Readers should be warned that in one book, published in English, the rook is said to be more valuable than the king — ignore this book and, probably, anything else not published by the Shogi Association.)

Those of you who have read my articles on chess will know that the second most important feature, after material, is mobility. In fact the chess pieces have material values which are not entirely disproportionate to their average mobilities, so it would be possible to write a chess program that was governed by present and potential mobility, rather than by material and present mobility. In shogi, since material values cannot be defined in the same way as they can in chess, mobility is possibly the most important feature. We define mobility in shogi in the same way as we do in chess — the number of squares attacked by a piece.

The attack on the enemy king is of greater importance in shogi than it is in chess. For this reason, two features which are employed in many chess programs are absolutely vital in a shogi program: King Attack and King Safety. A primitive measure for King Attack is found by adding 2 points for every attack on a square which is not more than three squares distant from the enemy king, and 1 point for every possible move to a square from which such an attack can be made. The sum of these attacks and potential attacks provides a measure of the extent to which a player's pieces can operate within the vicinity of the enemy king, and the extent to which they control possible flight squares that might be used by the enemy king to escape from a strong attack.

King Safety can best be measured by taking into account the number, nature and proximity of friendly pieces that are situated near the king. If your king is surrounded by many of its own pieces it will be much safer from attack than if it is in an exposed part of the board, with few of its own pieces nearby. As in chess, it often pays in shogi to keep the pawns in front of your own king as defensive pieces, obstructing the attack of the advancing enemy. In addition, it is useful to have two or three generals (golds and silvers) near your king for added protection. The different shogi openings usually define a particular defensive formation for the king, so by reading about the openings you will learn the various defensive formations and you can design a feature for your evaluation function based on giving bonus points for having your own king well protected by the correct piece.

Gaining material in a game of shogi is useful for two reasons, and some method must be found to reflect this fact in your evaluation function. When you capture an enemy piece you deprive his king of a certain measure of protection if the captured piece was near to the king this protection will be much greater than if the piece was many squares away from the king. You also have an extra piece 'in hand' which may be used later in the game to achieve some strategic aim or to expose the enemy king still further during the blistering attack which you launch prior to checkmate. One way in which your program can measure the value of a captured piece lies in the loss of mobility experienced by your opponent when you capture one of his pieces. Another way is simply to add a certain number of points for every piece that you hold in hand.

So far, we have discussed only a very small proportion of the total number of shogi principles, but these are among the most important. A computer program which takes into consideration mobility, king attack, king safety and the number of pieces held 'in hand' would be able to play a game better than the novice who has just learned the rules of the game. One very important aspect of shogi is the mating attack, and this is one area in which your program will be able to play better than many humans, because it requires pure calculation.

The mating attack

In shogi there is no endgame in the same sense as there is in chess. Because captured pieces can reappear on the board, it is rare for a shogi game to end when the board is almost completely devoid of material. To win at shogi you must launch a successful mating attack. We have already discussed two of the evaluation features which can help a program set up and develop an attack against the enemy king. The tactical phase that ends the game will often contain a long, forcing sequence of moves that is difficult for many human players to spot. A computer program should have no such problems, provided that it is looking along the correct path of the tree.

The answer lies in knowing when to search for a mating continuation, and in ignoring all other factors when looking for a mate. It is normally sufficient to have four of your own pieces attacking the enemy king area, so your mating routine can be triggered by a test which counts the number of your own pieces which impinge on any of the squares which are within (say) three squares of the enemy king. If this test provides a positive result, the program can then look along all variations in which its own moves are checking moves. During this phase of the game all other moves may be ignored, on the assumption that if he is given a single move's respite, your opponent will be able to bring another piece to the defence of his king, or will move his king to a safer square. The routine which searches for mate should therefore be single-minded, and by ignoring all moves other than checks it ought to be able to search 7 or 9-ply deep, or even further. If no mate is found within some predetermined horizon, the program simply reverts to the middle-game search algorithm and looks for a move which improves its strategic control of the position.

How to deal with drops

As I mentioned earlier, one of the most serious problems in writing a strong shogi program is the very large branching factor caused by being able to drop a captured piece onto almost any vacant square on the board. (In fact you may drop onto any vacant square provided that (a) you are not dropping a pawn, lance or knight onto a square from which it will never be able to move; (b) you will not have two unpromoted pawns on the same file at the same time; and (c) you do not drop a pawn in such a way as to give checkmate on the move.) How can we reduce the branching factor without ignoring most of the better drops?

The answer lies in identifying a number of key vacant squares (say ten) and examining drops only onto those key squares. This can be accomplished by using the evaluation function to measure the improvement in score that could be achieved by dropping a hypothetical piece (a 'genie') onto each vacant square. The genie has the power of all the other pieces combined, and by estimating its effect on the mobility, king safety, king attack and other features of the evaluation function, when placed on each of the vacant squares, it is possible to produce a ranking order for the vacant squares which indicates which squares are the best candidates for drops. By reducing the number of such squares from (at least) 42 to ten, we can reduce the total number of moves which the program needs to consider. This is especially important when more than one type of piece is to be held in hand.

If a Shogi playing program is too difficult

It is, perhaps, daunting enough to the reader for me to suggest that you learn a new game as complex as shogi without my adding to this suggestion with the thought that you should also write a shogi-playing program. You may feel that the game itself requires enough of your time, and that a shogi-playing program might be beyond you, especially in view of the paucity of literature on shogi heuristics. In that case, there is still one programming exercise which you will definitely find worth your

while, as it will test your understanding of many of the tree-searching ideas that we have discussed in this series of articles, and it will stretch your ability to write code that executes efficiently.

Just as there are many people who are interested in chess problems ('White to Play and Mate in two Moves'), so there is even greater interest in shogi problems. An extremely interesting programming exercise can be found in writing a program which will search for checkmates. In the composition of a chess problem it is part of the composer's task that he must not allow a checking move to be the key to the solution. In shogi, the opposite is true

all moves in a shogi problem must be checks or replies to check.

A program which solves shogi problems must therefore employ an efficient test to determine whether or not a move is legal (ie, whether a reply to check achieves the aim of moving out of check), and whether or not a move gives check. These two tests are sufficient, since a move which fails both tests is inadmissable in the tree search. Your problem-solving program has only a very small number of branches at each node, and so a deep search is possible without the program consuming enormous amounts of time. There is not too much scope within a problem-solving program for speeding up the search without the use of heuristics, but one or two notions do suggest themselves. Prefer a checking move that is near to the enemy king to one which is further away (reason -- a far away move allows more interposing possibilities). Prefer a 'safe' checking move to a move which allows the free capture of material (reason -- with more pieces of your own side on the board, you have greater chances of forcing mate). Prefer to evade check by moving the king than by interposing a piece (reason -- an interposing move may allow a free capture). Prefer to evade check by capturing the checking piece than by moving the king (reason

the less material your opponent has on the board, the harder it will be for him to force checkmate).

Of course, these rules of thumb all have very many exceptions, but other things being equal (which they never are) all of them have some value in ordering the search.

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Fairbairn, J: *How to Play Shogi.*
Shogi Association: *Shogi* (magazine).

The reader is strongly warned against all other shogi literature published in any language other than Japanese. Up to the time of writing this article (May 1981) no other accurate literature is known, and errors in the rules and the moves of the pieces abound.

COMPETITION

Modern microcomputer technology has many applications, but one where it has so far had little impact is in reducing the problems of disability.
To mark the designation by the United Nations of 1981 as "The International Year of Disabled People", *PCW*, in conjunction with the IYDP Technology Working Group, is holding a competition for the best article on the subject:
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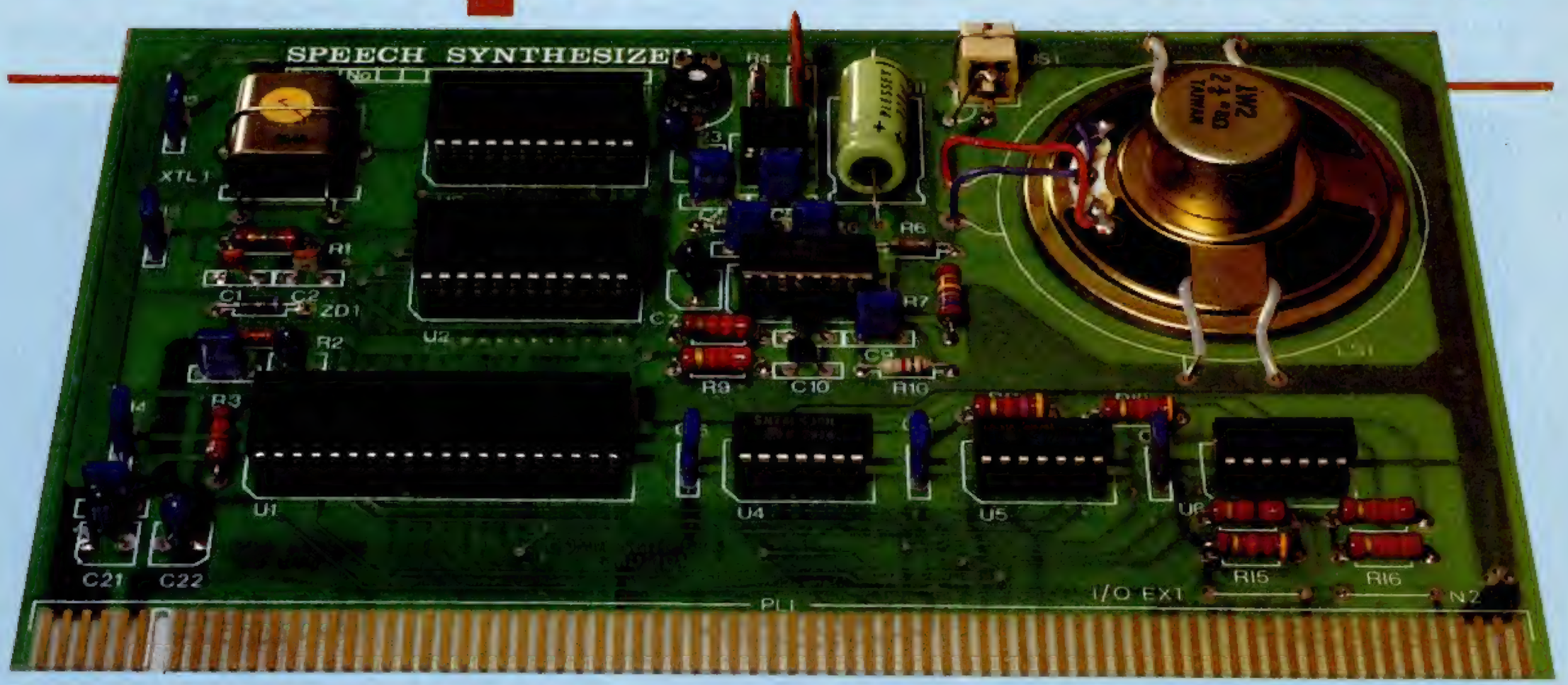
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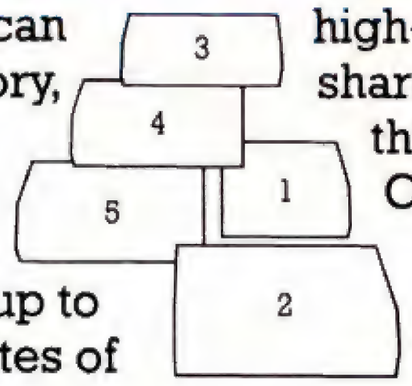
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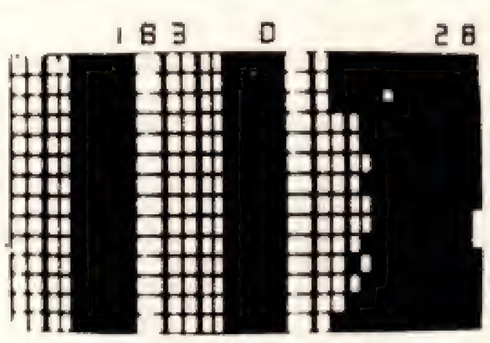
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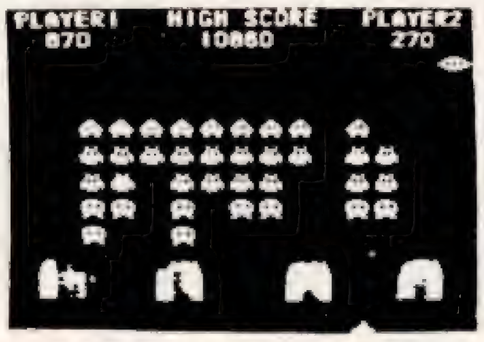
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BANKS' STATEMENT

NIP IN THE AIR

This month we're pleased to introduce Martin Banks, who'll be giving us a monthly overview of the micro world.

I was sitting in the kitchen earlier today (I am writing this quite late at night as it happens — which it usually does). From where I was sitting I could see a wondrous panorama of that jewel of English architecture, Luton. Watching a beautiful sunset of blues and reds that followed on a day when it had rained, blown a gale and done most of those things that are generally unconducive to thinking wonderful thoughts, it occurred to me that there was some form of symbolic parallel between the weather and the UK microsystems industry. Then I thought that perhaps I was taking the idea a little too far — you know what I mean, the industry being damp, full of wind and quietly fizzling out in a well stage-managed and terribly dignified demise.

I decided in the end that I was right but not completely so; some of the original symbolism hung together somewhere and so I thought about it some more. And then. . . and then. It came back to me. Over recent weeks several events have occurred in and around the industry that have changed the longer-term perspectives on the micro scene and changed them not just in good old Blighty but throughout the world.

The things? One is the Japanese presence; another is the position of the existing major computer manufacturers; another is the existence or not of a new consumer market and products to fill it. Each and any of these would have a significant impact on the shape and feel of the micro world. Put them together, however, and the changes are likely to be fundamental, long term and very painful for some people and companies.

But for whom, I hear you ask, will they be painful? Well, I'll tell you. The people and companies that are likely to suffer most are the very companies that began the whole business in the first place — the Commodores, Apples, Tandys, Cromemcos, etc, etc, which manufacture the hardware that the dealers and retailers sell in this country. They are the ones in danger of suffering the glowing sunset of dignified demise. And there is evidence to suggest that part of the reason will be the fact that elements of the distribution chain essential to their success — the dealers and retailers — appear to think they are full of the symbolic water and wind.

Let's start by looking at the Japanese and the effect they are likely to have. For reasons that are much too long, complicated and contentious to go into here, Japanese industry has been able to organise coherent and cohesive plans for targeting selected market areas, developing well-engineered products suitable for the market and then manufacturing them and marketing them in sufficient volume and with sufficient skill to acquire significant shares of that selected market.



One of the contenders: Oki's BMC if 800

Japanese companies have done this in shipbuilding, motor manufacturing, consumer electronics and semiconductors. They are also doing it in computers, starting at the mainframe end with kit that is plug-compatible with IBM and then working down.

Having seen the growth in the market for microcomputer systems, the Japanese are now ready to move in in a big way. To do this, of course, means not only having the right products but also having the distribution networks. Here, the Japanese have a distinct advantage over the American and European manufacturers. Through the way they have taken over the consumer electronics marketplace, they have learned all the good and bad points of running a distribution network. They now seem intent on using that knowledge to the full in the micro business — and many dealers can hardly wait.

Dealers are naturally reluctant to be quoted on their views but rebellion against the dominant US manufacturers is growing in their ranks and fond eyes are being turned Eastward. 'We welcome them with open arms', one said to me. 'They trade differently. They don't want to put you out of business.' He went on to say that Japanese suppliers could easily make dealers change their current allegiances on the question of suppliers.

Another said he knew of several who would probably dump their US suppliers when the Japanese got going properly and waxed lyrical about such items as support and reliability. Several dealers talked about the 'paternal' attitude of the Japanese towards them, about the Japanese wanting to work in partnership. Closer to reality, they also mentioned the better margins on sales that the Japanese provided, allowing the dealers themselves to offer better support to the customer.

A measure of the expectations held out for the Japanese by the dealers is the fact that all were convinced that a Japanese company will be number one supplier in the UK within two years. This against a background of unanimous agreement that none of the Japanese are yet ready or in a position to assume that mantle.

The current leading contender in the UK is Sharp, with its MZ-80K, selling at the rate of around 500 a month and climbing. This is being followed to market by the 3201 business system and the MZ-80B scientific system. Sharp's manager, Paul Streeter, who concurs with the generally held view of the company's fourth position in the UK marketshare rankings, says that this has been achieved with a system not suited to the main growth market in the country, the small business and 'occupational' sector.

'The keyboard is wrong,' he says of the '80K, 'and until we got CP/M running there wasn't much of the right software.' With the new 3201 he hopes to have this last fault corrected. The provision of suitable software is seen by everyone as the one factor holding back the Japanese rush. And though Sharp is currently the leading contender, there are and will be others. There are some smaller Japanese companies already pitching in the market and the likes of NEC and Matsushita are preparing to jump in.

Bob Gleadow, UK general manager at Commodore, doesn't feel they will go for the business market, preferring to wait for the emergence of the consumer market proper. He also states that they have been able to take advantage of the market development work put in by the American companies. 'They have learned from our mistakes in the market,' he says, 'but we are capable of operating at their standards of products and support.

The marketplace demands an increase in support in many areas.'

Despite this, Sharp's new 3201 and NEC's 8000 series machines show that the Japanese want a share of the business market as well as the consumer one. The American manufacturers are in for a tough fight and it looks as if they may not be able to count on too much support from their dealers.

The question of dealers and distribution brings me to the second point: the position of the existing computer manufacturers. Companies like IBM, Digital Equipment and Xerox have quietly sat on the sidelines watching the cut and thrust of the micro market and watched it develop from the non-important area of funsters and hobbyists into a big money operation that is beginning to take market-share away from them. As one Digital Equipment supplier in this country put it to me recently: 'I visited a small company the other day that was running invoicing on a PET and it worked.'

All three companies are now dabbling in the distribution end of the business, opening retail outlets at least in part to learn the rules of the game. It can be assumed that they will be tolerably quick learners and it can be taken as a certainty that they will have suitable products. Take IBM, for example. The company, and I quote, 'never speculates on future developments' but it now has two shops in the UK, has been playing with its own personal computer system for around two years and has been talking to Matsushita in Japan about buying a small system from them. Take DEC; it has been working for over two years on a single-chip LSI-11 processor.

'IBM has been talking to Matsushita in Japan...'

With companies like these it is not so much a case of them becoming like horse-drawn coaches — superseded by events — even though there are several industry observers who contend that this is possibly the case. Instead, it is more likely to be a case of waiting to see how things develop in the marketplace and then being ready to make a move. I am not suggesting that once they do make their moves, these companies will have a divine right to the micro-market (if no-one else does, the Japanese will ensure that) but only a fool would undervalue their chances.

BANKS' STATEMENT

NIP IN THE AIR

The third point is the consumer market — whether it exists and what products will serve it. One man who feels the time may be right to test the water is HB Computers director Mike Hambly, who has decided to set up the aptly-named Computer Supermarket in Corby, Northants. He is aware of the gamble he is taking, saying quite blithely: 'In two years time I will be a millionaire, or have fallen flat on my face.' The gamble is, in fact, two-fold, for not only is he taking on the trials and tribulations of setting up a new company in a business noted for its fatalities but he is setting out to create a sector of the market that has palpably failed to materialise so far.

The consumer sector represents, at best, only ten per cent of the marketplace, and the general frailty of user users when it comes to subjects like software has effectively blocked concerted attempts to merchandise micros.

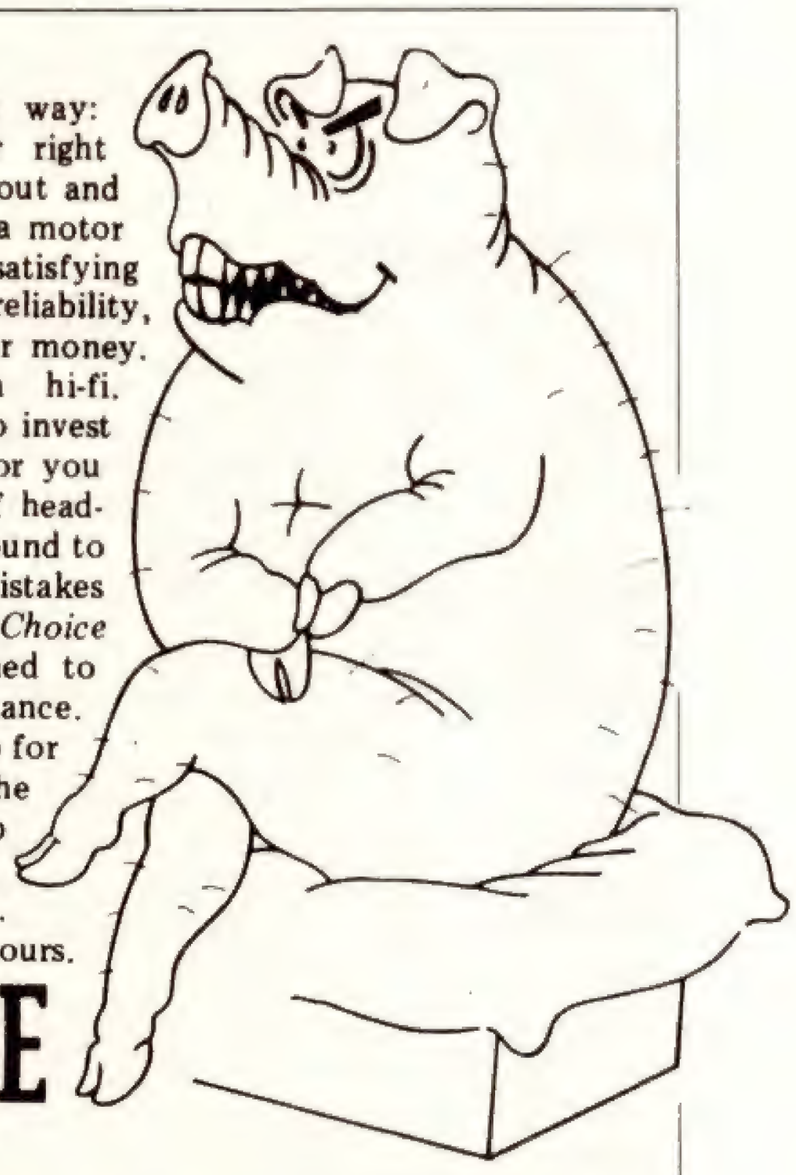
This situation will certainly change in time and there are signs that the changes are on the horizon — speech I/O, expensive use of firmware, use of the public telephone system, etc — and some of them are now beginning to appear, or at least be talked about with some certainty. Then, the consumer micro market will be as significant as the pocket calculator was ten years ago. I cannot say with any confidence that I feel it has happened yet.

One thing is certain, however. When it does occur, it is likely to be the Japanese companies that come up with the goods.

Put all these points together and it becomes possible to see why I suggest that changes are round the corner. The changes are both in the products themselves and the mix of companies that manufacture them. The small companies that started this business have had to struggle to get going, and some have become tolerably large companies in succeeding. By succeeding, however, they have also started to tread on some painful corns. Some will survive but they won't all be Davids against the Goliaths.

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ACORN ECONET

BENCH TEST

Sue Eisenbach and Chris Sadler continue our series of Multi-user Benchtests with a low-cost British system.

Everybody is talking about Acorn Computers Ltd, most of the interest being focussed on the BBC's choice of Acorn to supply a machine around which to base its first consumer computer series. This has generated a wide range of comment in the press, particularly in connection with the eccentricity of Acorn's Basic dialect. The second interesting event has been the announcement of Econet, which appears to offer multi-user computing at an incredible and unprecedented low cost.

The idea behind this network scheme isn't new — you start with a small, cheap, stand-alone microcomputer and arrange for several of these to be linked to something which lets them access a common disk system, a printer or any other expensive or esoteric peripheral which it may require occasionally but not continuously. In this way a collection of PETs can be clustered by means of the Mupet, Apples by means of Nestar and Acorn Atoms by means of Econet. Of these, the last is the cheapest, British and the subject of this month's Benchtest.

Hardware

An Econet system consists of three elements — the nodes (or 'stations') which comprise two or more microcomputers, each with a processor, some memory and possibly peripheral devices; the network cable which carries the information between nodes; and the Econet interface card, one of which must be installed in each active node. The review system comprised four fully configured Atoms (c f, Atom Technical Data, for a brief sketch — or Mike Dennis in *PCW*, July 1980 for a full review); one Acorn System Three (a 6502-based machine built on the Acorn Eurocard bus and featuring a single mini-floppy drive); a Seikosha printer and a number of lengths of four-way cable with standard five-pin din connectors. This is by no means the maximal network — the current Econet will support some 255 stations while a future version is planned to cater for 64k nodes organised as a hierarchy of up to 255 local networks, each comprising up to 255 stations.

Each station has a unique address which is hard-wired into the interface card. Stations number 255 and 235 are respectively designated the File Station and the Print Station. This is because if these facilities are required on the network (and it is reasonable to expect that they would be) then each of the microcomputers located at these nodes must be dedicated to the running of a program called the File Server and the Print Server respectively. On the review machine, for example, the File Station uses the Acorn System Three with its floppy disk but the printer was attached to one of the Atoms which had, consequently, to be sacrificed (as a user station) every time a print-out was required. The next revision of the network software (to be apparently written in machine code, rather than in Basic as is the current one) is expected to offer sufficient flexibiltiy to allow several File and/or Print stations on the same network. However, there are no plans to combine these two functions into a single node (an obvious saving), nor to offer hard-disk facilities.

The Econet interface card comes in two versions: one for the Atom, plugging into the top (ie, wrong) side of the PCB — a thin strip of board right above the keyboard; the other for the Acorn (Systems Two, Three, Four or Five) — a Eurocard which slots directly into the Acorn bus. Both require a 4k machine code program starting at A000H and, at least in the case of the Atom, is stored in ROM. The Econet software is boot strapped into the local processor on power-up or when < BREAK > is pressed.

In the design of a network, it is necessary to define how the information to be transmitted on the network is to be made up (often called the 'packet'); how it is to be transmitted and how all the traffic on the network is to be regulated. On the Econet, much of this work is handled by the Motorola MC 6584 ADLC (Advanced Data Link Controller) which is housed on every interface card. When one station wants to send a message to another, its Econet software will structure the body of the message into one or more packets which are passed onto the ADLC. Each packet contains source and destination identification codes (one byte each), a one-byte 'port-number' which serves to identify the nature of the message (eg, a command or a piece of data, etc) and the information itself. The ADLC then constructs a 'bit-frame' which contains the packet suitably converted into a serial data-stream, enclosed by start and stop bytes (otherwise known as open and close flags) and a 16-bit CRC (cyclic redundancy check) — see diagram. Obviously, on reception of such a bit frame from the network the ADLC will strip off the extra bits and reformat the messages as parallel data which it puts on the local processor's bus.

Before it can transmit a packet, it is necessary for the ADLC to determine the state of activity on the network. An idle state will be seen by the ADLC as a stream of logic 1s (at least 15 bits long) whereas in a busy state (ie, another ADLC transmitting somewhere) logic 0s will have been inserted into the bit stream (Zero Bit Insertion). Thus, each ADLC can 'listen' to the network and will only transmit when the network is free.

However, this does not deal with the 'collision' problem when two ADLCs hear nothing on the network and begin transmitting simultaneously. Should this occur, the information actually on the network becomes corrupted, a circumstance detected by both transmitting stations which listen to their own transmission. These will then back off until the network is clear again. In order to prevent this from happening over and over again, each station generates a unique 'arbitration code'. As soon as the colliding stations have backed off, they rotate their arbitration codes and interrogate the top bit. Depending on its value, they either return to listening or try to retransmit. Since the two arbitration codes are different, eventually one will get the opportunity to transmit without interference. In fact, each arbitration code is made up of eight 1s and eight 0s so that any station has a 50-50 chance of going first following any collision. This is also probably necessary to conserve uniqueness under rotation — it will be interesting to see how Acorn copes with arbitrating among its proposed 64k stations. Assuming that a station manages a successful transmission, it first sends a 'scout' message (the first few bytes of the packet) and only transmits the remainder when the receiving station has acknowledged and indicated its willingness or ability to receive the frame. During the entire transaction the two participating stations have complete control of the network and any other station wanting to transmit would find the network in a busy state.

Physically, the network cable consists of two twisted pairs — one for data transmission and the other for



clock signals (in both directions). For short networks, shielding is not necessary, although it is recommended for longer runs. Any configuration is possible (provided there are no loops), although a straight-line hook-up is recommended for larger networks since the signal deteriorates over spurs and branches. Branch connectors are such that the electrical continuity of the network is not dependent on whether or not any individual node is switched on. (Incidentally, neither the Acorn nor the Atom appear to have on/off switches anywhere on the casing.) The clock signals are generated by one station, designated the 'master-station'. (Jumpers exist to configure any Econet interface card to perform this function.) These are used to synchronise data transfer. The clock frequency recommended by Acorn depends on the size of the network. The review system was rated at 250 kHz which would have been good up to 300 m. For networks up to 1.7 km (sounds suspiciously close to a mile), 107 kHz was recommended.

Talking of recommendations, Chris Curry of Acorn Computers felt that a typical Econet configuration will probably consist of as many Atoms as required (fully expanded) and probably an Acorn System Five as the File Station. This has two (Tandem) double-tracked, double sided minifloppies (800 kbytes disk storage) and probably 24k of RAM. Since this is the top-of-the-line in file servers, this works out a bit more expensive than the Econet might appear at first sight.

Software

There are several different parts to the software available on the Econet. Firstly there is the Econet interface program installed in 4k of ROM in each station. This features the network operating system (NOS) together with its low-level primitives. The latter consist of six routines used in the construction of the high-level NOS commands (see later) and are available to programmers at assembler language level. TRANSMIT and RECEIVE are the lowest level and have obvious functions, while PEEK and POKE have their normal meanings except they act on another user's memory (this network is the ideal environment for the programmer who is also a busybody!). RESET and START are even worse — RESET tells a distant station to stop what it is doing and wait for a START instruction (so that its memory can be examined/altered in peace), while START itself passes a memory address to the waiting station and causes it to begin execution there.

The high-level commands under NOS can be used in immediate mode or embedded in Basic programs. Some are inherited from Acorn's Cassette and Disk Operating Systems (COS and DOS respectively). These are *SAVE; *LOAD; *CAT(alogue) and *DELETE. The * serves to designate these as NOS commands rather than commands to the resident Basic system (eg, LIST, RUN, etc). Other commands deal with specific network functions so that *VIEW n provides the user with a snap-shot of station n's screen.

Continuous 'viewing' can be achieved by

```
10 *VIEW 3 (for instance)
20 GOTO 10
RUN.
```

However, this viewing can never be entirely surreptitious since the victim's screen 'snows' slightly during each snapshot and the continuous interruptions slow down processing discernably.

Similarly, the command *REMOTE n will allow the user of a local station (not n) to take over station n (the remote station) entirely. Commands typed into the local keyboard will appear on both screens but will only be obeyed by the remote processor. On the other hand, the remote keyboard is disabled (except for break). So this is what you can do — type *REMOTE 3 (say) and take over station 3. You can load a program into memory, begin execution and the memory on your system will be unaffected. Meanwhile, the user at station 3 just sits helplessly watching. Unfortunately, when graphics mode is used, the signal does not get back to the local screen. Since *VIEW can transfer graphics signals across the network, we assume this is a bug in *REMOTE. While in remote mode, the remote station can be reset by typing 0 and remote mode itself can be disabled by the command *ROFF. The documentation mentions a further command, *NOTIFY n, which is intended to send a message to the screen of station n (or broadcast to all stations if n=0) — but we couldn't get it to work.

Finally, the printer station is accessed from another station by typing ^B (must be followed by 'delete' due to a bug in the current software) and disabled by ^C. The effect is the same as ^P under CP/M in that anything appearing on the screen will be reproduced at the printer. That completes the range of commands recognised by the NOS. They are simple to use and appear to be reasonably efficient, if a little limited. The network error messages are clear and worth mentioning:

NOT LISTENING: station referenced is switched off
NO REPLY: fault during transmission
BUSY: peripheral in use
TIME OUT: peripheral not used for extended period (eg 15 secs) so link between station and printer severed
NO! FILE SERVER: attempt to *REMOTE the file station.

The second part of the network software consists of the peripheral utilities. These are called 'servers', so there is a 'file server' and a 'print server'. Both of these programs have to be executed on the processors at the relevant stations before the network is ready for use. The file server must run at station 255. Every time a file is referenced by another station (ie, SAVEd or LOADed) an entry is made on the file server screen. This consists of the name of the file and other information like its location on the diskette, etc. When the file server is booted in, every station on the network is made known to the file server by a program known as BOOT. A 'qualifier' can be associated with each station — presumably this will be used in future versions to define the status or privilege of users on that station, in so far as this status affects access to disk-files. Likewise, the literature mentions a number of commands covering file operations (including random access), directory operations, and disk operations, including defining and altering public and private access rights. Our file server, however, could only LOAD and SAVE Basic programs or *LOAD and *SAVE small (less than 20 kbytes) chunks of memory. The file server runs on an Acorn System 3, 4 or 5.

The print server on the other hand runs on an ordinary Atom to which a printer is attached at station number 235. When another station types B at command level (or $2 in a Basic PRINT statement), it gets control of the printer station until ^ C (or $3 in a Basic PRINT statement) is typed or until there is no transmission for several seconds, after which the print server will disengage itself and type 'TIME OUT' on both the printer and the attached station. Should any other station try to get the printer while it is engaged, a 'BUSY' message will be received and the user will have to try again later.

The third software element includes user utilities and language translators. At the moment all that is offered in this department is Acorn's Basic with Assembler which is supplied in ROM on all Atom stations and on disk in the file station. For those readers who cannot remember Mike Dennis's fairly extensive coverage of this dialect, here is a list of the more idiosyncratic highlights, both good and bad points:

1. 32-bit precision integers named A, B, . . . X, Y, Z (ie, only 27 allowed).
2. Floating point variables and strings designated by non-alphanumeric prefixes (eg, $ for strings, etc). Arrays referenced by double character variable names (eg, AA).
3. The prefix '?' has the effect of a PEEK or a POKE depending on the context.
4. The PRINT statement does not automatically append a < CR > — this must be done explicitly.
5. The construct DO < statement > UNTIL < condition > is supported.
6. The command LINK can be used to enable the incorporation of assembler mnemonics directly into the Basic source. (This is how the NOS primitives can be utilised in programs.)

Finally, under NOS it is not at present possible to create or access data files except as chunks of memory referenced by starting address and length.

While we had the Econet, we had the opportunity to preview Acorn's new Pascal. This has not yet been released and is currently missing some features which it will need before it can be regarded as fully viable. We received a letter from its creator, Paul Farrel, telling us as much and asking us not to Benchmark it as all the debugging statements were still in. A fuller description of the language itself will be given in a future article but we cannot resist publishing our Benchmarks (floating point tests excluded — not yet implemented); they make quite interesting reading when compared to other 6502 Pascals.

A Pascal compiler would be a very definite boon to the Econet system but the snag seems to be that part of the compiler's address space overlaps the Econet interface program's space so with the current design this can never be. Perhaps future configurations will support a disk-resident relocatable Pascal which can be down-loaded onto individual stations.

In conclusion, we found that the Econet seemed to have very promising potential as the basis of a low-cost network but feel that interested readers should wait until the following enhancements and extensions (some under development or mentioned in the specification, some not) have been implemented and proved satisfactory, before committing themselves to the Econet.

For the NOS:

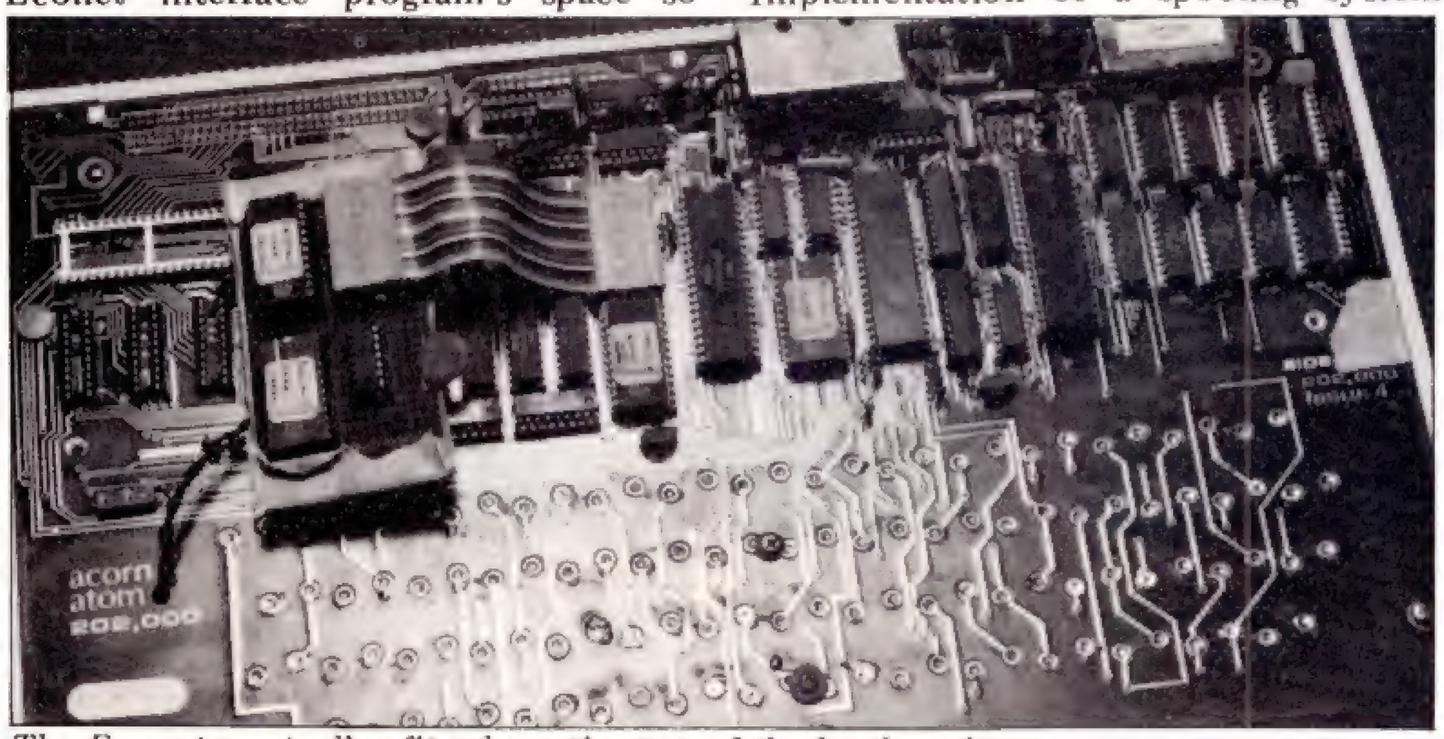
1. Some means of restricting availability of powerful network commands to 'privileged' stations;
2. Wider range of high level commands providing easier access to NOS primitives;
3. Provision for more than one file or printer station on the system and amalgamation of file and print stations;
4. Pascal.

For the File Server:

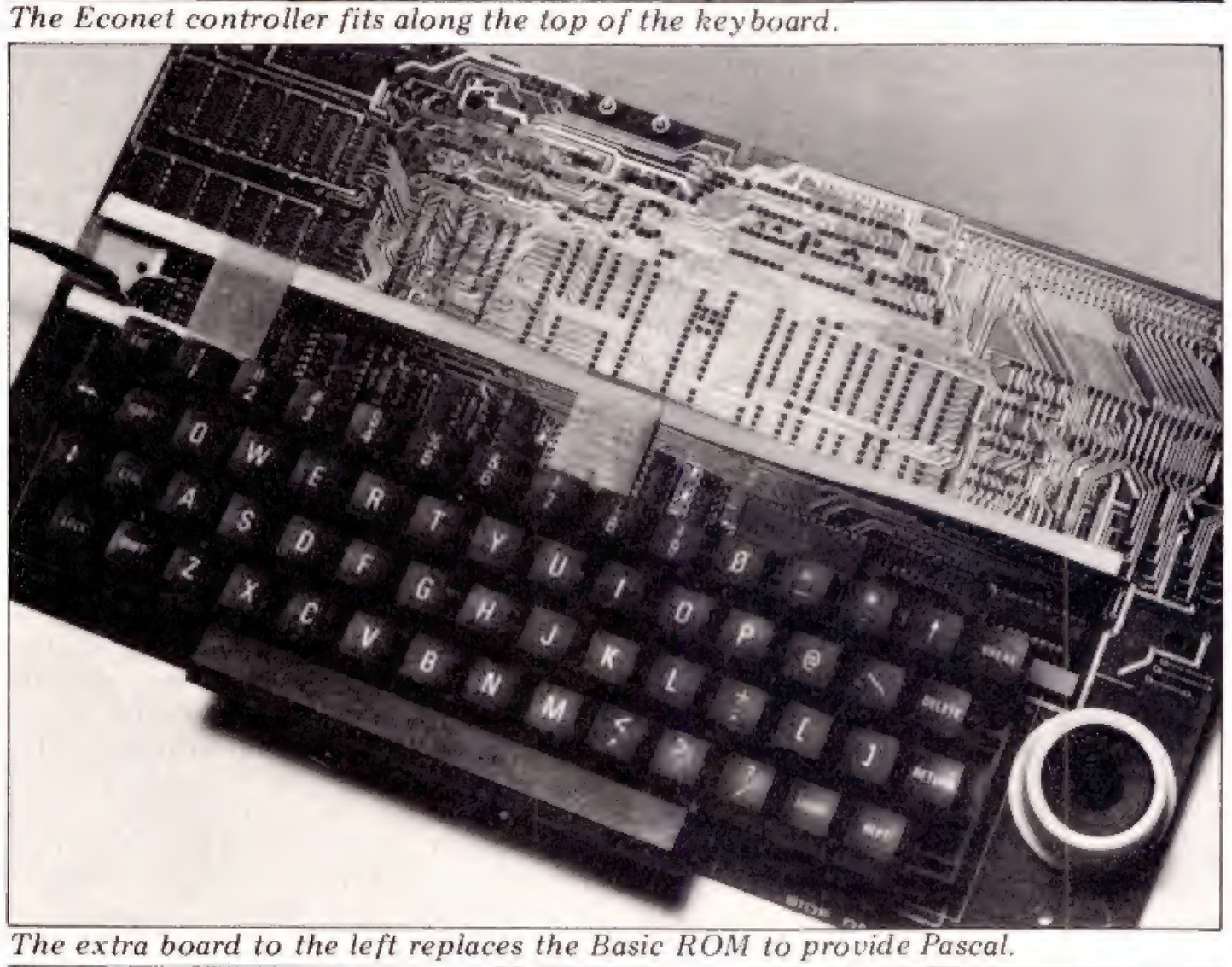
1. A simple yet robust security system for user files;
2. Provision for data-file manipulation within programs;
3. Provision for hard-disk or other massive file-store.

For the Print Server:

Implementation of a spooling system whereby output from different users is temporarily stored on a disk and queued to the printer when it becomes free.



The Econet controller fits along the top of the keyboard.



The extra board to the left replaces the Basic ROM to provide Pascal.

Benchmarks

The multi-user Benchmarks take on a different shape when run on a network. For instance, the test designed to tie up a single processor will not show any effects when each user has a processor. On the other hand the file accessing tests are crucial and here, unfortunately,

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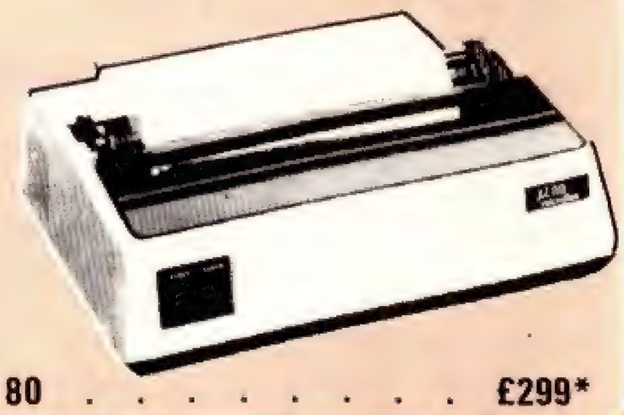
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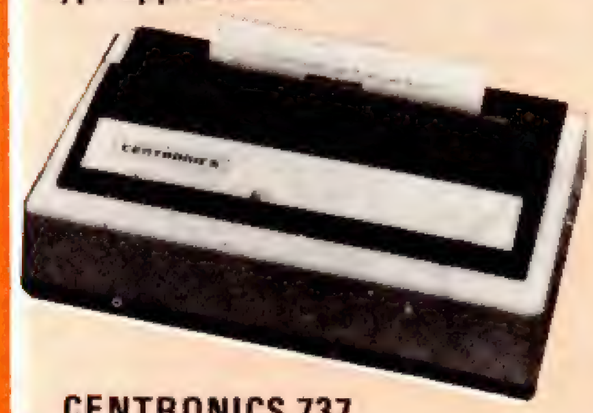
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we were not able to test as fully as we would have liked. There are two disk tests, each designed to transfer 100 128-byte records to and from the disk. In the first test, the file should be opened and closed before and after each write and read, while in the second test the file is opened for 100 writes, then closed, then opened for 100 reads before finally being closed again.

Since the Econet would not allow data files to be accessed from within a program we had to be content with transferring chunks of memory onto the disk and retrieving them. Since each such transfer involves opening and closing a file we took this activity to be roughly equivalent to the first of the tests described above (ie, the 'short record' disk test). For the second test, we would have like to transfer 12,800 bytes in one go but this proved too much for the file server so we were reduced to transferring 1280 bytes ten times. This gave reductions in timing of the order of one quarter, so, extrapolating, one could expect improvements of a factor of one quarter again for the full disk test. However, there will have to be considerable changes in the software before these tests can be run properly.

M-U Benchmarks	1 User	2 Users	3 Users	4 Users
Processor Test	33.2	33.4	33.4	33.3
I/O Test	119.5	120.1	119.7	120.0
Short Record Disk Test	161.4	321.8	482.7	643.2
Long Record Disk Test	37.9	71.2	107.3	137.7

Finally, as promised, the Atom Pascal Benchmark figures:

magnifier	2.4
forloop	31.3
whileloop	80.7
repeatloop	71.0
literalassign	47.7
memoryaccess	46.8
realarithmetic	—
realalgebra	—
vector	126.1
equalif	86.0
unequalif	83.4
noparameters	13.4
value	33.0
reference	27.4
maths	—

Potential

Acorn bills the Econet as a 'low-cost local computer networking system for schools, business and laboratories'. Firstly, let it be said that the system certainly is low-cost but, owing to the unbundling (literally) of chunks of essential hardware, it is not as low-cost as it might seem. For instance, you've probably seen the Atom advertised at £120 but you've still got to get hold of a (separate) power supply and monitor (total price £142) becore you could get it up and running. Or you could make do with a domestic television.

Bearing this in mind, each station on the Econet therefore consists of three boxes (computer with keyboard, monitor, power supply) plus interconnecting wiring, plus network cable — so anyone planning an installation should consider building in this wiring (and installing on/off switches nearby).

Despite this, on a cost per machine basis, the Econet appears to be an attractive proposition for schools — this view has been endorsed by the DOI. Schools need to provide systems for pupils to learn programming on and to run CAL software on. For the former, an Econet system could be a slightly dubious solution. Firstly, a multi-user system in a school environment must be reasonably secure, and the File Server available for review purposes offered no security. The thought of 20 pupils each on their own machine but each with the capability of deleting and altering everyone else's files and memory, as well as the ability to disable keyboards at will, would deter all teachers save those who take particular delight in anarchic chaos (or strict disciplinarians.) In fairness, however, Acorn has promised a more secure system. Secondly, there is only a very limited choice of languages available on Econet stations. A strange dialect of Basic and Assembler may not be everyone's idea of the ideal teaching machine. (The Pascal and Econet software occupy the same address space, so cannot be used together.) Finally, the Atom in particular (that is, the 'cheap' solution) has space in its case for a maximum of 12k and this may not be sufficient for A-level pupils to write their projects on. Besides its price, in its favour are the 250x192 resolution graphics, sound and interfacing capabilities useful for CAL and other computer applications. However, there is a dearth of quality software around to exploit these capabilities.

It is hard to see the Econet, as it stands, fitting into a business environment, where there is a need for robust hardware (and lots of it — eg, hard disks), robust software (and lots of it, such as ledgers, financial planning packages, databases, word processing stuff) and good file security. However, Chris Curry did mention that independent micro firms were developing software to connect several major micros into the Econet (Apple, PET, Research Machines 380Z) which may carry the type of software which business users expect to have. However, there is some doubt that CP/M will perform quickly enough to satisfy the Econet's protocol.

The laboratory user is probably Acorn's longest established type of customer and it is probably in the labs that the Econet will fit with the least trouble. The Acorn systems provide a wide range of extremely useful cards and even the Atom comes with a Versatile Interface Adaptor option. Also, laboratories are accustomed to having cables and connectors leading hither and thither and a cheap, easy-to-use network could prove an excellent and efficient way of collecting, manipulating and storing lab data. The Basic, although eccentric for teaching programming, seems well-suited to lab applications.

Documentation

The (prototype) Econet system which we reviewed was supplied with a spiral-bound 'Atomic Theory and Practice', covering Basic and Assembler for the Atom, together with several typescripts including 'Econet Version I — User Manual'; 'Acorn (Econet) Technical Manual'; 'Acorn DOS Manual' and a long document entitled 'Atomic Network Operation' which appeared to be some sort of promotional specification for the Econet.

Of these 'Atomic Theory and Practice' was the only document in its final form and, as a microcomputer user document, is of a reasonably high standard. It is 212 pages long, is paginated, includes a table of contents and succeeds in being entertaining and informative with numerous examples. Apart from the DOS manual, the other documents appear to be preliminary versions of different ages and variable accuracy, generated during the Econet project, and describing features some of which do not yet exist. No doubt they will become more accurate as they are prepared for final publication but the overall impression is again of reasonably well-written clear descriptions of features and of technical specifications, complete with circuit diagrams. The style of these, however, is not a tutorial nature, in contrast with 'Atomic Theory'.

Expansion

The minimum Econet consists of two linked Acorn System Twos each with a few k of memory, an Econet interface and only machine code capabilities; one with a cassette for backing store, Currently the maximum an Econet can contain is 255 Acorn System Fives each with 64k memory and two double sided double tracked minifloppy drives (no file-server), along with a wide assortment of interface cards. The Acorn sales literature promises even larger systems with up to 64k stations connected on subnetworks, all talking to each other and to other computers on the much faster Cambridge Ring.

If there are hardware limitations on an Econet, it isn't with the number of stations one can attach to it but with the size of each station. Larger and faster (Winchester?) disks are needed for a network of any size. On the software side, Acorn offers a fairly limited choice of options for future expansion and extensions to its sparse catalogue of system software would not go unappreciated.

Prices

As there is a wide range of products that can appear in an Econet configuration, the list below is a sample of the more commonly purchased products. These prices exclude VAT.

Minimal Atom kit with integer Basic	£120
Fully expanded Atom with graphics and floating point Basic	£250
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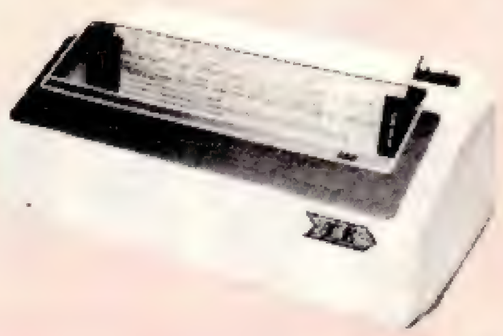
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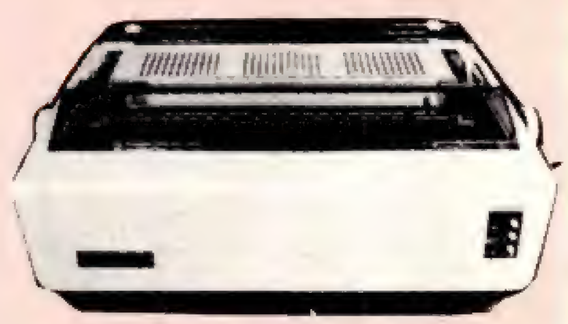
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1 keyboard	£ 96
5 b/w monitors	£ 680
4 Atom Econet cards	£ 200
1 Acorn Econet card	£ 60
4 mains adaptors	£ 32
1 Seikosha printer	£ 195
Assorted cables and connectors	£ 20?
Sum	£3058
VAT	£ 459
Total	£3517

The price of a four-user system based on an Acorn System Three File Server would be:

Review Machine (a three-user system + printer)	£3058
1 maximal Atom + monitor + power supply + Econet card and cables.	£ 449
File Server	£ 100
Sum	£3607
VAT	£ 541
Total	£4148

The price of an eight-user system based on an Acorn System Five File Server would be:

9 fully configured Atoms (with Econet card)	£4041
1 Acorn System Five	£1650
1 keyboard, monitor, and Econet card	£290
1 Seikosha printer	£ 195
1 File Server	£ 100
Sum	£6276
VAT	£ 941
Total	£7217

Although an Econet system is inexpensive per station (for the three-user, four-user and eight-user systems priced above, the costs are £1172, £1037 and £902 per station respectively) the above calculations show that Acorn's ads are slightly misleading — 'A ten station network with 400 kbyte file station costs around £3000 and as little as £40 for each additional station.' Ten stations for £3000 implies that users have 2k RAM and no monitor on their Atoms, while £40 per additional station implies that the station has already been purchased and only the interface card is required.

Atom Technical Data

CPU	6502
Memory	RAM 2k-12k, ROM 8k-16k
Keyboard	60 keys incluidng cursor
Screen	32x16 alphanumeric (uc and reverse video), 256x192 point graphics
Cassette	Kansas City CUTS
Disk Drives	Not tested disk system with BASF drives promised
Printer	Seikosha printer (and other parallel printers)
Bus	Acorn's onw 64-way Eurocard socket
Ports	Cassette Interface, parallel port, Econet port
System Software	COS
Languages	Acorn Basic, BBC Basic (soon), Assembler, Pascal

Conclusion

The review configuration was delivered directly from an exhibition where it had received three days of battering from thousands of children. It seemed none the worse for wear. We had occasional hardware difficulties that didn't reappear when cables were disconnected and reconnected. Our overall impression was that the hardware was as robust as one could expect of a system with numerous temporary connections. For a permanent system, channelling for the cables would be strongly recommended.

The nicest thing about receiving a system direct from a show is that there was a full games disk. Numerous friends spent many enjoyable hours playing Dogfight, Rattrap, Astro, Space Invaders (all three versions) and Breakout. Although these games did not demonstrate the powers of the Econet, they did much to show off the Atom as an ideal inexpensive machine for games — complete with graphics (256x192) and sound. If Acorn had had multi-station games we might never have got around to returning its system, let alone writing this review...

Acorn Computers are relatively inexpensive, flexible bus-based microcomputers, ideal for laboratory use, whereas Atoms are very inexpensive, if limited, all-in-one micros. The Econet is an inexpensive method of hooking virtually any number (actually 244) of either of these micros together so that they can share more expensive resources. The hardware configuration appears to be quite sensible. Unfortunately, at the time this review was written, the accompanying software was rather primitive — and the software a user sees may make the difference as to whether a system is desirable, acceptable or useless. We hope that, despite having obtained the BBC micro contract, Acorn (whose products have always shown a streak of originality) will not become too pre-occupied to provide this potentially powerful system with the software support it so patently needs.

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SECRETS OF SYSTEMS ANALYSIS

PART 11: IMPLEMENTING A COMPUTING SYSTEM

Lyn Antill continues her series on bridging the gap between users and experts.

At this point in the series you will have worked out exactly what your system is supposed to be doing for you. You will have bought a machine and all the accessories — cables, paper, floppy disks, etc. And, finally, you will have either bought a program package or had a program written for you, and tested it. Now you are at the nail-biting stage — ready to go *live*.

Getting to know the program

You've probably done this already during the testing but perhaps some of your staff have yet to try it out. If you bought a package, you may not have spent much time using it, so it would be a good idea to practise. Get to know the manual or operating instructions. You may not be able to remember all the routines that you have to perform, but if you can understand what's in the manual then you can look up any tricky bits when you need them.

It's very easy to follow the set piece instructions which they often give at the start of the manual but it's not always so easy to sort out how to get started on your own data. If you have any doubts about doing this, then start with a few simple examples of your own work and follow these through all the stages until you are feeling more confident.

Often, the most difficult part of running a system is getting it going and since this is also the time when you are least familiar with the program and the machine, you have to be prepared for things to be a little more difficult. You're probably thinking that you've been patient for a long time now, working slowly and carefully through all the stages. Well, there's only one more stage to be careful about, so don't rush things now!

The changeover

There are basically two ways in which you can change over from one system to another. You can run the two systems in parallel for a test period, until you are happy that the new system is working properly, or you can go 'cold turkey' by switching one off and the other on. Each of these methods has advantages and drawbacks.

The advantage of a parallel run is the security it offers you. You can look at the answers you're getting from the new system and compare them with those from the old. If you like them, well and good; if you don't, then you can do something about it before you have to rely on the new system entirely. It is often not possible to run two systems completely in parallel — I doubt if your customers would like to receive duplicate invoices, or if you would wish to make payments twice over. But there's no harm in keeping two sets of books (as long as they agree).

Parallel running presents the same difficulties that I mentioned last month, in that you will often need to have the same piece of paper (such as a customer order) in two places at once and you will have to arrange a fairly careful clerical system to make sure that everything gets processed properly and none of these bits of paper get lost. This brings us to the final disadvantage of parallel running. Your staff simply may not have enough time to put everything through twice. Large companies can take on a few temps while the regular staff act as supervisors, telling the temps what to do. This may not be practical in a small firm, either because of the expense of hiring temporary staff, or because the work can only be done by someone who knows the system.

All the problems of duplicating your efforts can be avoided by making a sudden change, say over a weekend, from one system to the other. However, once you've gone over to the new system you're stuck with it. If you've found that it's got your records into a muddle, you'll just have to unmuddle them. There's no chance of having a quick look at what's gone through the manual system. This means that you have to be rather more careful about your testing and about the way in which you have entered all your old data. There is a certain amount of adrenalin in this approach which does help you concentrate, and to put more effort into getting the new system right. I still haven't forgotten the excitement of watching my first system go live in this way. It was in a bank, which was even more exciting because they are so careful about their records. Of course we did have some way of checking that the answers coming out of the computer were correct because the dealers kept their own records of their transactions, as did the cashiers. At the end of the day we were £3 million out! It took some frantic debugging to get things right but within three days everything was okay.

If you decide to go for the clean break, then you must have some way of checking your computer records — but then you should have that anyway. You cannot just rely on the computer getting it right for you. I doubt if the Inland Revenue or the VAT man would accept unchecked computer figures as an excuse for getting your tax returns wrong. Your auditor would not be impressed by this excuse and neither would it help you to keep a check on your stock position. There must always be some outside realities that you can check your computer records against money in the bank, stock on the shelves, carbon copies in the filing cabinets.

So, how do you decide which option to go for? Partly it will depend on how you feel about it. Are you a gambler by nature, do you like a bit of excitement? Or would you prefer the slow steady approach, even if it did involve some overtime? If it is vital that your records be accurate, then you must be sure that you have some way to check them, as the bank did in my example. If you suddenly change your stock records over to a computer and then find that the only way you can check them is by doing a complete stock-take each night, you may well decide that a parallel run would be preferable. However, if you can do a quick check against cash in the till, or against a manual list of work that you've run up as you were entering it into the computer, then the quick changeover would be quite safe.

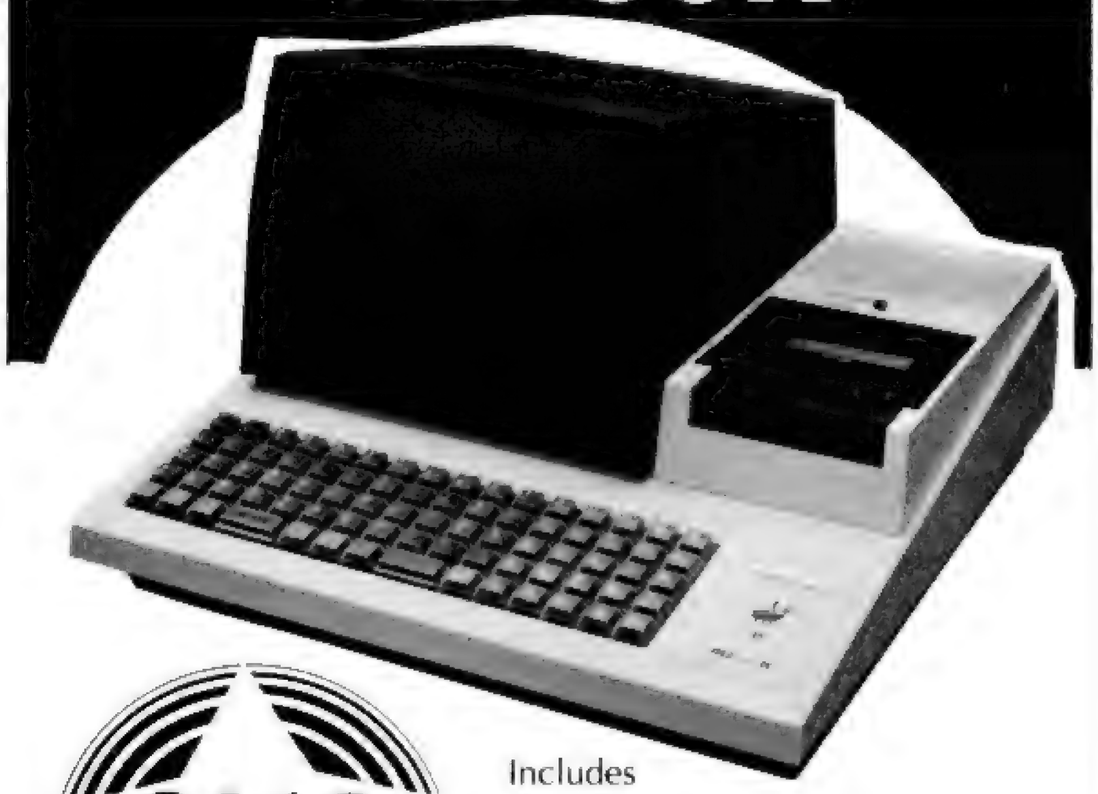
If both of these options seem to involve too much hard work at once, then you may decide to compromise in ways that many users of big computers would. This would involve doing a parallel run on one section of the work at a time, and can be less of a strain provided that it's easy to separate out an identifiable area which can be computerised without upsetting the manual operation of the other parts. With a book-keeping system, for example, one could start with the sales ledger and then add the invoicing, leaving the purchase ledger, stock control, etc, to a later date. Alternatively, you might try maintaining just a few accounts on the computer, as well as keeping your manual records. It all rather depends on how many accounts and transactions are involved.

Taking on the data

This has to be done carefully, because if you start off with duff data, nothing will ever be right. However, this presents far fewer problems for the micro user than for someone with millions of records to enter into a mainframe. The chances are that you can get things up over a weekend, or at a time when business is slack.

Is the data already in the right sort of format? You may be unlucky and find that your existing records don't keep quite the same bits of information as you're going to want to put on the computer, or else that you're going to be combining data from two different

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the correspondent
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places. If that's the case, then it might be difficult to copy stuff straight from your existing books into the computer. It might be easier to do the job in two stages. Find out exactly what data you're going to be entering into the computer — what items, in what order, is there any limit on the number of characters in a given field, or on the value of particular items? Create a form on which you can write the input data. Try it out on a few records just to make sure and then get loads of them printed off.

Before you can take on any data, you have to call a halt on the processing of anything on the old system. Do whatever checking you can on the old system and then leave it alone. Decide on the order in which you will work through the old books and stick to it and that you don't walk off and leave anything halfway through — you'll only lose your place! It really does pay to check and double-check at this stage. Jobs like going through all your customers and copying their names and addresses are so boring, and so simple, that you will make the incredible number of stupid mistakes. If you cannot put the data straight into the machine, then fill in the forms you have prepared, check these and then type the data into the computer. You'll need to check your typing against the forms but you should also cross-check it against the old records where possible.

You may, again, be faced with the problem that there is just too much data to take on at once. A possible way out of this is to enter all the fixed bits of data first. Things like names and addresses aren't going to change much over a week or so and can be entered as and when time's available. Once that's been done, operations can be suspended over a weekend, while the volatile bits of information, like balances and stock quantities are added. This reduces the amount of work to be done during the frantic period with a consequent increase in the likelihood of everything being done properly with minimum disruption to your business.

Running the new system

It is always difficult getting used to something new. This is the time when you are most likely to make a mistake, and when you will find it most difficult to correct any mistakes because you don't quite know how. This lack of familiarity with the system can sometimes make an operator feel a bit harrassed; others react very differently because they are enjoying the novelty and may try to rush ahead. Either way it is important to build up good habits right from the start. Apart from all the normal good office habits of orderliness, etc, there are specific procedures associated with a computer system. Most important of these is taking backup copies of data and programs and the safe keeping of floppy disks. Everybody will get the occasional data corruption, but there is no doubt that some people get more than others, because they are careless.

A microcomputer is part of a complete system and its operation must be meshed in with all the other things going on around it. Once programmed, it is just another bit of office machinery which must be treated properly and which will soon find its place in the working routine. You'll soon find what you can and can't get away with but do try to avoid any disasters in the early stages — they're bad for morale!

One thing that always surprises programmers is the way in which users manage to adapt the way they use programs to deal with more applications than were originally intended. A non-programming user tends to take the program as given and uses his imagination to see other uses for the data. One technical college showed me their student records system in which they had to condense a lot of information into a limited number of fields. When the operator discovered that she needed to store an extra field after a student had withdrawn, she simply put the data into a space that would have held something else but which wasn't needed any more. Sc the program was doing an additional job and she hadn't had to call in the programmer. Even if she had, he would have had difficulty finding any extra space.

Running a system on a microcomputer isn't so different from running it any other way. You still have to be methodical and work out procedures for doing and checking each stage of the work. We're back with the 'dumb clerk' I talked about at the beginning of the series. The micro is a willing, but unintelligent, clerical assistant. The only sense in which you have to be more careful when operating a micro is in the keeping of data. You always did have to

GOTO page 142

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TOM'S TANDY PROBES PRANGS

Road accidents cost Britain dearly, not only in terms of human misery but also in the £1.5m it costs the taxpayer each year. David Tebbutt reports on a man who's doing something about it.

Bill Jones was driving home after a pleasant weekend with friends. Feeling relaxed, he was keeping to the country lanes well away from the rush of the motorway traffic. His attractive wife was by his side and his two young children were playing happily in the back. A split-second later, the car was a mangled heap at the roadside, he and the children were all badly injured, and his wife lay dying. Another car had hit them head-on. Its driver and four passengers were also badly injured. The road was wide enough for the vehicles to pass each other and neither car was anywhere near the speed limit allocated to that stretch of road. So what happened? And, more importantly, what can be done to prevent this sort of horror?

Tom Ravensdale is a man who knows the answers.

The Company

Tom runs an accident research and investigation company in East London. He is regularly approached by solicitors and insurance companies who need to know as accurately as possible what happened in an accident. Sometimes the approach is made years after the event, and Tom has to unravel the truth from a mass of often-conflicting statements, plus any evidence which may have been collected at the time of the accident. He always visits the scene to take his own photographs, make measurements and note things like tree positions, type of road surface and so on. He then works through all this information, extracting the relevant bits for subsequent entry to his accident research program suite which runs on a Tandy TRS-80 microcomputer. This suite incorporates formulae derived from the laws of Newtonian physics first observed by Galileo and later formalised by Newton in the 17th century, together with the results of more modern activities, such as the American research into crush factors. By crashing cars into solid objects, a team has produced tables of the energy required to produce different degrees of distortion of vehicles under various circumstances (angle of impact, whether the collision is with a solid or moveable object, etc). Other files within the system hold details of every common motor vehicle used in Britain, including information such as kerb weight, ground clearance, tracking and centre of gravity.

Tom, together with his system, is then able to assess the likely cause of accident and, if necessary, stand up in court as an expert witness and make statements like: 'Car A was travelling on the correct side of the road at between 49 and 53mph immediately prior to the accident.' This sort of statement by an expert is absolutely invaluable in unravelling things like insurance claims. The fact that Tom cannot be more precise in his speed estimate would be irrelevant if, for example, this accident happened in an area where the speed limit is 30mph. It is clear that the vehicle in question was exceeding the speed limit.

Tom's motivation to do this type of work is that he feels very strongly that many accidents are clearly avoidable and there is no need for the annual carnage that takes place on our roads. Did *you* know that every year 6500 people are killed on Britain's roads and God knows how many are maimed for life? Go into the orthopaedic ward of any hospital and count the number of motorcyclists receiving treatment — it will usually be the majority of patients. Each year 70,000 motorcyclists are killed or injured in Britain alone.

Tom is at heart a researcher; in addition to running the business, he is currently investigating motorcycle conspicuity at Loughborough University — trying to find answers to questions such as: should motorcyclists drive on dipped beams; what colour clothing shows up best? It is to fund this sort of activity that Tom actually runs his company. This means that he drives himself extremely hard, usually working 18 hours a day and often as many as 20 or more.

Background

In order to explain how this business came about it is worth delving a little into Tom's past. When he was a child he had an almost obsessive interest in Gray's *Anatomy*. By the time he was ten he probably knew more about the human body than most of us ever find



out. Unfortunately his parents regarded this interest as 'perverted' and 'dirty' and made a habit of walloping him whenever he was caught reading the book. Tom even took to reading it beneath the bedcovers by candlelight. This was all very well until the day he set his bed on fire and almost killed himself! Anyway he survived and went on to lead a most remarkable life.

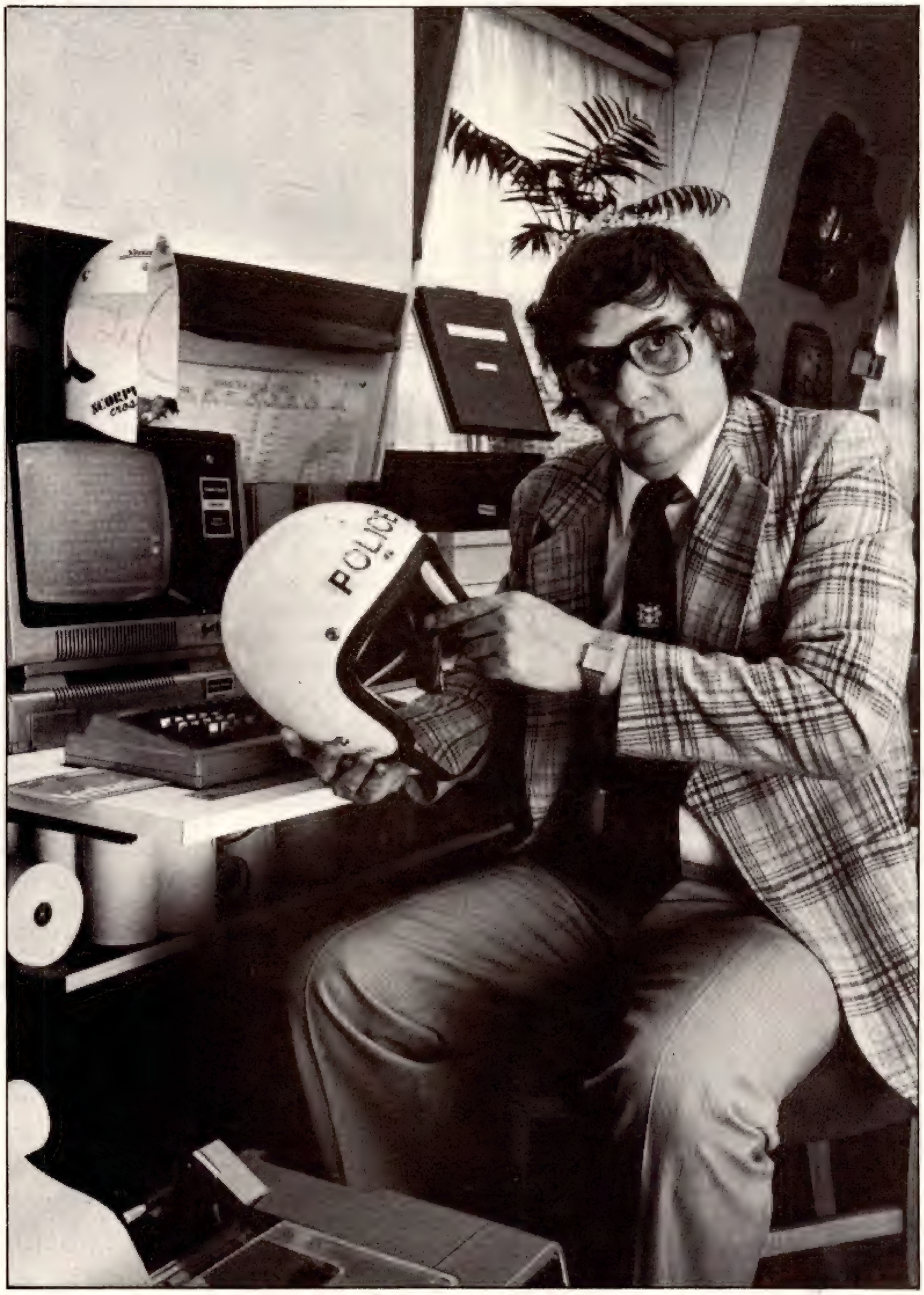
When he was 14 he left home and roamed around Europe doing odd jobs, returning to England after a few months only to be picked up by the police and taken home. As soon as he was 16 he was off again and became very interested in motorcycles. For nine years he toured the world racing bikes, using the start money from one race to finance the trip to the next. Now, while Tom won his fair share of races, he also had more than his fair share of accidents. He even managed to fracture his skull twice — once in Japan and then again at Brands Hatch. His final accident happened in Casablanca, where he broke his back.

Spending several months in plaster gave Tom the opportunity to reflect on his life and it also brought him the opportunity to study. Before leaving hospital Tom had passed ten O levels and three A levels. This was just the beginning of an amazing amount of study which was to bring him several degrees and diplomas in the years to come.

It was while carrying out research into the use of biological simulations in teaching at Reading University that Tom was approached by the Home Office to carry out a 12-month study into the effectiveness of police motorcycle helmets. Tom jumped at the opportunity of involving himself in a campaign very dear to his heart — that of road safety. Apart from 'considerable personal experience of crashes', Tom had once staged an exhibition called Operation Skidlid. He had gathered together a number of his racing cronies to exhibit their crashed bikes and to try and persuade youngsters to wear crash helmets.

Tom embarked on this study with his usual enthusiasm, getting various sponsors to pay for trips to accident research laboratories around the world so that he could take advantage of all the accumulated wisdom of that time. During this work, Tom had a need for information about the types of injury sustained in motorcycle accidents and, as a result, spent a lot of time with a team of doctors, surgeons and pathologists at the London Hospital Medical College, examining people who had died or been injured in such accidents and correlating this information with his findings after examining their crash helmets. One of the interesting things he discovered was that if you paint or use certain solvents such as petrol on a polycarbonate crash helmet, you render it virtually useless. Tom duly wrote his report and presented it to the Home Office.

By now Tom had really got the road safety bit between his teeth again, so he set up an accident research unit in the London Hospital with the 'massive help of the Metropolitan Police'. According to Tom, these men really bent over backwards to help him. He attended accident investigation courses at Hendon Police College and in the United States, and he's particularly proud to have studied under Stannard Baker at Chicago's North Western University Traffic Institute. Tom attended and investigated several hundred accidents during this research and his final report earned him a Fellowship of the Institute of Professional Investigators.



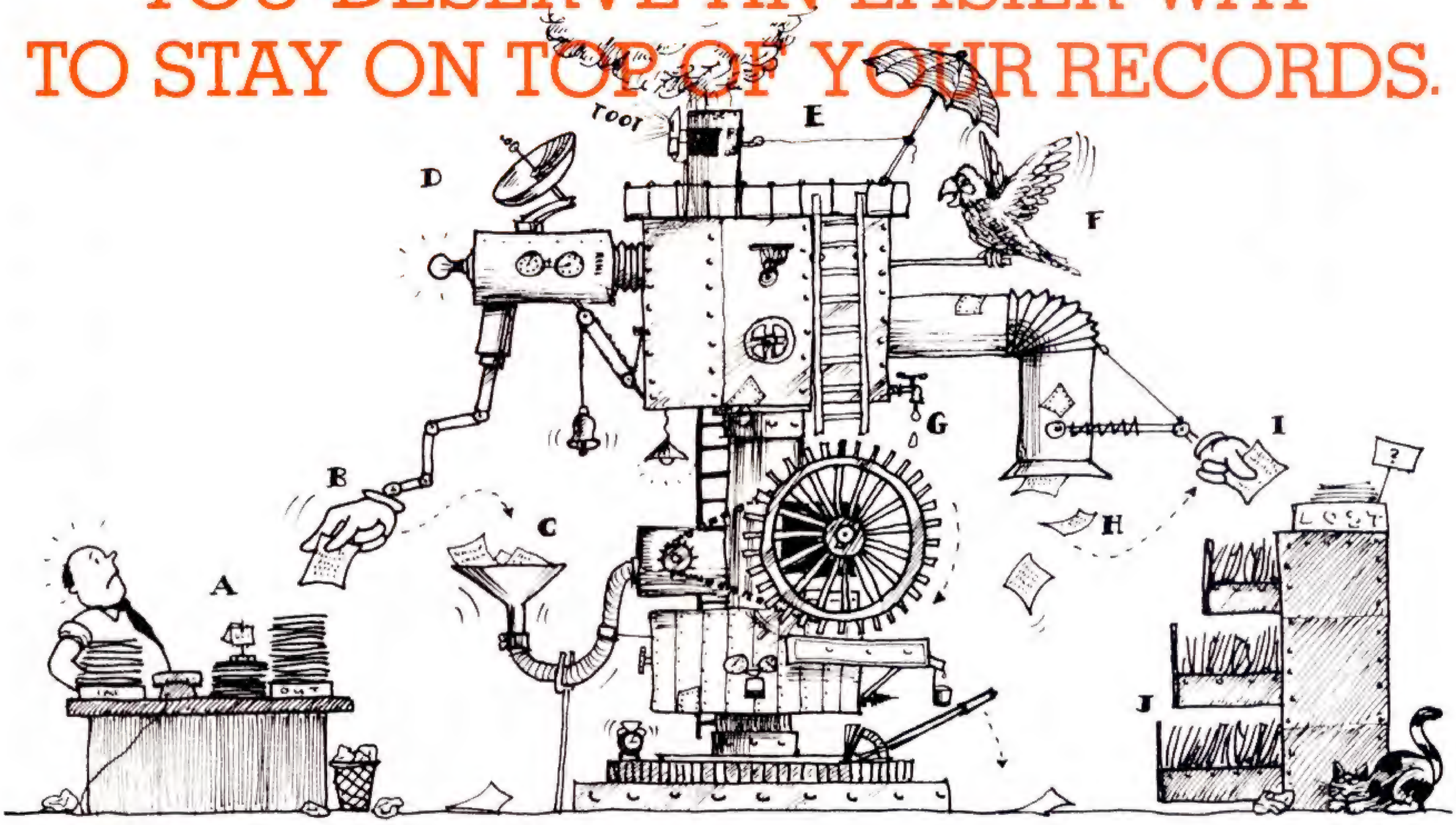
Tom Ravensdale

Towards the end of this particular study, Sir Thomas Lund came on the scene. Sir Thomas was probably best known for his efforts in setting up the Legal Aid and Advice Scheme in Britain. He was Secretary (and subsequently Secretary General) of The Law Society from 1939 to 1969 and he was also instrumental in founding the British Academy of Forensic Sciences. It was this last activity that was to lead him to Tom. Sir Thomas suggested that Tom could continue his research by providing an independent and unbiased accident investigation service to solicitors and insurance companies. Sir Thomas figured that since the police have access to experts to help them discover what happens in accidents, then the public should have the same opportunities. Tom and Sir Thomas then set up the present company — Private Accident Investigation & Research Ltd — to perform precisely this service. Tom runs the company with the help of his wife Soraya and his son John, plus a number of medical and ex-police consultants. Sadly, Sir Thomas died during the course of my investigation for this case study.

An Investigation

On my final visit to Tom, I asked if we could work through a case together and, rather than present my findings in an abstract, academic way, I shall describe

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exactly what happened, making just enough changes so that the particular case can't be identified.

We started with a bundle of notes and photographs provided by the solicitor, together with other notes and photographs taken by Tom at the scene of the crash. The bundle contained masses of correspondence between the people involved in the accident, the insurance companies and the solicitors. In addition there were statements taken by police from victims and witnesses, insurance claim forms, plus maps of the scene drawn by both the police and by Tom. Had there already been a court case relating to the accident, then the court record would also have been in the file.

The particular accident I worked on is the one mentioned in the opening paragraph of this article. Mr Jones was indeed driving along on his own side of road when a car coming in the opposite direction hit him head on. The accident happened in the rain on a curve and a number of people were injured. Tragically, Mr Jones' wife died of her injuries. A witness to the accident claimed that the car which hit Mr Jones' vehicle was on the wrong side of the road at the time of the accident. From impact damage and the vehicles' final resting positions it was easy for Tom to confirm this statement.

According to all parties involved, there was water lying on the road. The police noted that it extended right across the road for a distance of some 30ft and lay about a quarter of an inch deep over most of its area. The tyre pressures and tread depths for both vehicles had been recorded by the police and Tom made a note of these. He also noted the make and type of each car involved. Finally he extracted details of the curve, specifically the chord and middle ordinate lengths. These were to be used later to work out the radius of the bend.

Armed with this information, we moved across to the computer. Tom's machine is a 48k TRS-80 Model 1 level 2 with four disk drives, two printers, an acoustic coupler and upper/lower case characters. He's tweaked the drives so that the Tandy ones have 40 tracks and the Micropolis ones have 80. One of the printers is a unidirectional, upper-case only machine while the other is bidirectional with full upper- and lower-case characters. The first thing we did was to establish the radius of the curve. Tom called up the appropriate routine, popped in the chord and the middle ordinate figures and was presented with the result:

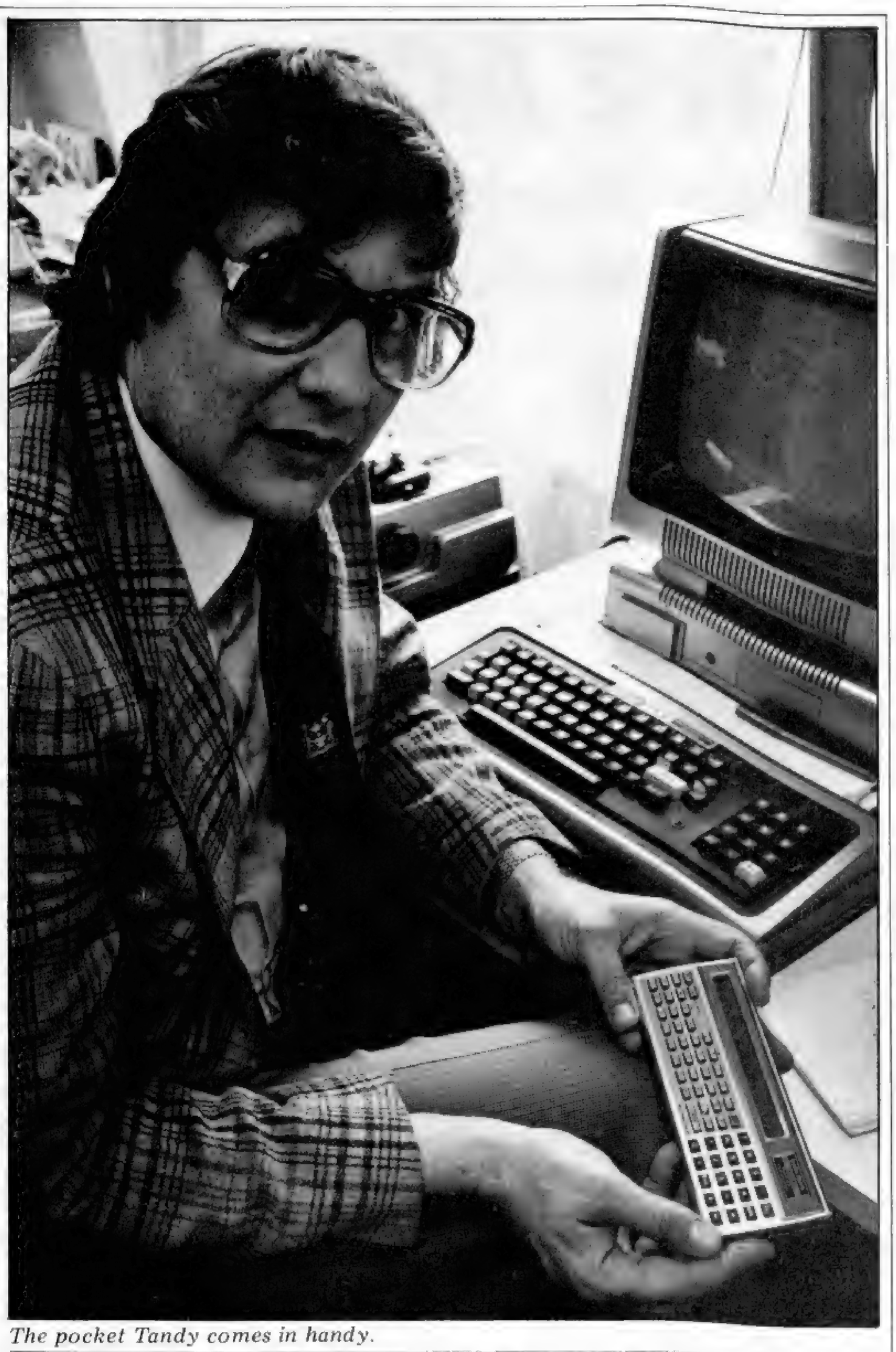
WITH A CHORD LENGTH OF 110 FEET AND A MIDDLE ORDINATE OF 2 FEET, THE RADIUS OF THE CURVE WILL BE 757.25 FEET OR 230.961 METRES.

Although Tom was instinctively aware of the sort of speeds that such a curve would allow, he still went through the full procedure so that I could understand properly.

The next thing he did was to call up a routine based on a standard police formula which works out a safe negotiating speed for a given curve, taking into account camber and the coefficient of friction of the road surface. You may notice that this particular formula takes no account of the type of vehicle. The notes revealed an adverse camber on the road and Tom entered the camber angle followed by the coefficient of friction which made allowance for the fact that the road was wet. Immediately the system presented a result:

THE CRITICAL SPEED FOR A CURVE WITH A RADIUS OF 757 FEET AND A COEFFICIENT OF FRICTION OF .5 WITH AN ADVERSE CAMBER OF 1 IN 25 IS: 72.0052 MPH; 105.89 FEET/SEC; 116.267 KPH; 32.2964 METRES/SEC. THE ACCELERATION/DECELERATION RATE IS 16.1 FT/SEC/SEC.

The next thing to do was to look at the make and type of vehicle. Tom keyed this in and his 'vehicle data retrieval' program responded with all the relevant facts about that particular car; namely the kerb weight, gross weight, height, width, length, wheelbase, front track, rear track, ground clearance, turning circle, engine size, maximum speed and centre of gravity. The system then went on to give details of the maximum safe speeds for this particular vehicle, taking these factors into account:



The pocket Tandy comes in handy.

WITH A RADIUS OF 757 FEET, A RADIUS OF GYRATION OF 2.5 FEET AND A CENTRE OF GRAVITY OF 1.78 FEET, THE MAXIMUM SPEED WITHOUT OVERTURNING IS: 56.278 MPH, 82.7137 FEET/SEC; 90.8196 KPH, 25.2277 METRES/SEC.

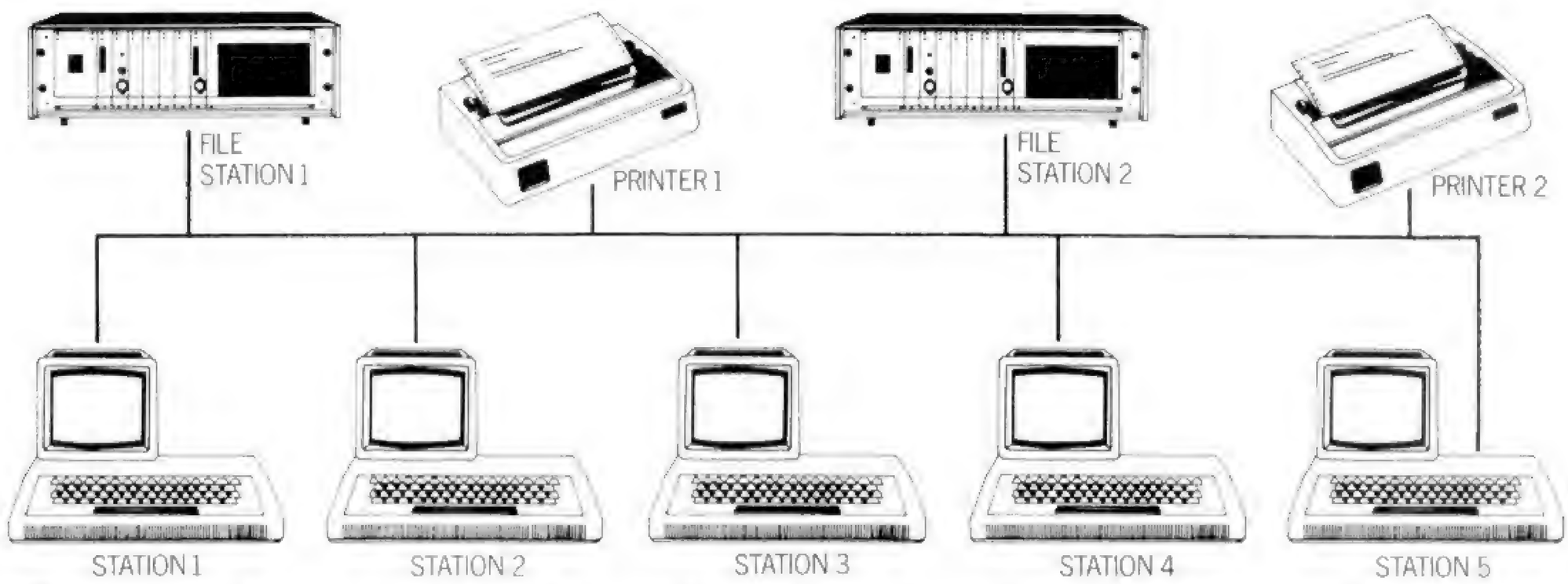
Interestingly, the system told us that the maximum safe speed for this particular vehicle under these conditions is only 56 mph.

In order to doublecheck the findings so far, Tom entered details of the damage to each vehicle. To help him do this, a menu appeared which offered the choice of eight types of impact. He chose a head-on impact with another vehicle and entered the depth of crushing at the front of the car. The system replied with an estimated speed on impact of 42.9mph.

Since the collision speed for both vehicles (we had checked the other car, too) was considerably less than the theoretical critical speed for that curve, Tom had to look for possible causes of the loss of control. You'll remember that a quarter of an inch of water was

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HOW THE ECONET WORKS

All the stations on the Atomic Network are connected together in the network by ordinary 4-wire cable. There is no specific direction of flow of data; the network simply ensures a path between any pair of stations.

1. Before transmitting on the network a station listens until the network is free.
2. If two stations transmit simultaneously the 'collision' is detected by a circuit on each station's Econet interface and both stations stop transmitting.
3. After a collision is detected, each station causing the collision retries immediately, or abandons the attempt and continues listening until the network is free again. The course of action taken is determined by a 'collision-arbitration' algorithm ensuring that no two stations go through the same sequence of actions.

In practice these procedures give very efficient use of the Econet, with the minimum number of retries.

During the time that two stations are in communications the network is kept continuously busy, so there is no opportunity for another station to interrupt and cause a collision. Once the conversation is finished the network is released, and other stations waiting to use it will again compete to gain access to it.

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● Each Atom station costs less than a typical terminal on a timesharing system. ● Each station runs programs at maximum processor speed; extra stations don't slow the system down. ● Each station is independent; a fault on one station doesn't affect the others. ● The Econet is far more flexible than a timesharing system. ● Extra facilities can be added as self-contained units.

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PCW 7/81 E

lying on the road, so Tom dug out the notes for an earlier hydroplaning (we often call it aquaplaning) accident. He'd worked out some new formulae for this type of case, based on tests conducted by NASA on the effect of depth of water on runways for landing of aircraft. Tom wrote a new piece of code and patched it into the system while I sat there. He then provided it with the appropriate figures, including tyre pressures taken from the police report, and the system replied by telling him that the maximum 'safe' speed for this curve ranged from 47 to 51mph under these conditions.

The message was clear: the curve at the time of the accident was not safe at much more than 45mph. In fact, the local council had rated it as a 60mph road when it should really have been rated as a 30mph road, since the figures arrived at during this investigation were all maxima.

As a final check, Tom re-read the case notes and one of the police statements said that they had tried negotiating the bend under similar conditions and they'd experienced great difficulty controlling the police car at more than 50mph. Needless to say, this paragraph almost leapt out of the page at us!

In this way, Tom is able to use the same methods he has always used to do his accident investigations, except that now the calculations are done in a fraction of the time it used to take.

The example we worked through highlights only a few of the many facilities that Tom has built into his system. One of the major functions gives him the ability to break down a skid into fractions of a second, showing the speed and position of a vehicle at each moment. He can, using standard driver perception and reaction times, establish where a pedestrian might have been prior to an accident. Until recently, if a pedestrian had been knocked down on a crossing, the driver has usually been given the blame. Tom can tell, for example, whether the pedestrian was actually on the pavement when the driver realised that he or she was about to run out into the road. He can also tell to a certain extent whether witnesses are telling the truth. On one occasion someone told him that they'd heard the skid, rushed out into the road and seen the crash happen. Tom was able to demonstrate that this was impossible since the accident happened on a curve and that the sound of the skid had first taken a while to reach the witness's ears. The witness had then to run into the road in order to see the site of the accident, by which time it would have all been over. In a similar way, Tom can work out things like who might have been first to enter a junction in a crossroads collision. He can even calculate the speed of each vehicle prior to impact from their final resting positions.

The list is almost endless. In the case of accidents involving motorcycles, Tom can work out the relevant details from vector analysis, which takes into account the resting places of both the bikes and the riders. Tom is currently perfecting a new series of equations which deal with vehicle speeds estimated from projections and trajectories.

Apart from a few utilities and his own system, the only other program Tom uses regularly is his Scripsit word processing package which produces all his final reports.

Computing background

Tom first encountered computers when he was an Open University student in 1972. At that time he was purely a user making use of statistical packages, although one of his courses was a systems course. He was to wait a further five years before becoming heavily involved in the programming side. In 1977, while studying for his Dip FE in research statistics at Garnett College, Tom finally found the need to use the college computer. His particular requirements were so specific that he had to learn to program in Basic in order to put the system to good use. Since that time, Tom has spent an average of four to five hours daily writing programs in Basic. Of course, having access to a college machine isn't quite the same thing as having your own computer, so Tom bought a TI59 programmable calculator. This was fine for a while, but then he knew he had to get something more powerful — but what?

Now you're hardly going to believe this, but another of Tom's many talents is that he is something of an electronics wizard. He once designed and built a burglar alarm for a motorcycle which started by issuing a spoken warning to a would-be thief if he tampered with the lock. If he sat on the bike, the thing threatened the thief that it would call the police. If he then tried to ride off on it, it did call the police and it screamed to passers-by that it was being stolen. The reason I mention this is that Tom used to haunt his local Tandy store for his electronic components. Just at the time he realised he needed more computing power, he popped into the shop where he saw his first personal computer — a TRS-80. A little bit of research showed Tom that he couldn't get a machine of similar power more cheaply so he went back to Tandy and bought himself a tape-based system, using his oscilloscope in part-exchange!

Starting off with very simple three-line programs which helped him assess vehicle speeds from skid marks, Tom swiftly moved to the more sophisticated routines mentioned earlier in this article. As he encountered a new type of accident, he'd work out appropriate formulae and pop them into the system. It is in this way that the system has grown during the past two or three years. Tom reckons that this accident research suite won't be finished for ten years at least, if ever.

So there we have it: a man who knew that he needed some sort of tool to help him with his complex accident research equations went into a Tandy store and found just the thing. Of course, Tom quickly became frustrated with the cassette tapes and he soon upgraded to a pair of Tandy disk drives. As the database grew, Tom bought a couple of Micropolis drives and, as the printing load increased, he decided to buy a printer. Before long he outgrew even this, which is how he ended up with his present four drive, two printer system. Tom is absolutely delighted with the equipment and considers himself very fortunate for making the decision to buy Tandy.

It is interesting to note the similarities between Tom and people like David James (see 'The Last One' in February's *PCW*). They are not computer people by profession. They are essentially users who are convinced that a computer will help them tackle many of their problems. They set about the whole business in an entirely unstructured way, doing a little program here and another there, satisfying their needs as they arise rather than working to some grand master-plan. As they go along they merge programs and bits of programs until they begin to have something which you or I might call a system. And the system works, because each element in it worked at the time it was first written. In this way, some enormously complex, and often untidy, systems are being created. I'm sure that this approach offends the purists but I'm equally sure that these same purists would still be stuck at first base trying to get the user to define his exact requirements before they dared start work on the system design. The fact is that people like Tom often don't know precisely what they want and to get them to commit themselves to ideas at such an early stage quite often robs them of the chance to use the computer's full potential. Now, I know that there's a place for both approaches but, having seen The Last One and now Tom's excellent system, I'd be the last to sneer at what I can best describe as an organic approach to programming — it just grows. I think that this marks just the beginning of the long-awaited micro revolution in which the power of the personal computer is wielded by the user instead of by the data processing industry which hasn't always operated in the user's best interest. And that's putting it mildly!

Some dire warnings

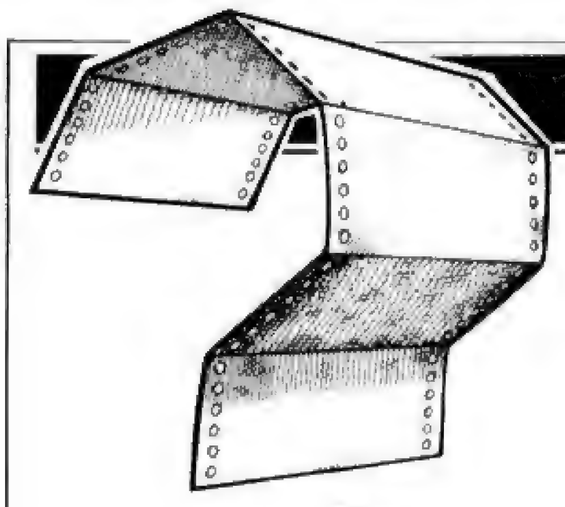
Tom is convinced that the computer is the most 'intellectually addictive device ever made'. He warns newcomers that they must be prepared to spend a lot of time on it if they plan to do their own programming. I'm sure that most programmers would agree that most five minute jobs end up taking five hours! It is because of the interminable hours spent at the keyboard that Tom suggests you buy the most comfortable chair possible because, while you're programming, you are completely oblivious to any aches and pains which might be developing. It's only when you stop that you realise you have the most awful backache.

When it comes to the choice of machine, Tom advises you to buy a 'High Street, mass market' machine which has plenty of software available. He didn't give a lot of thought to software and it wasn't until he'd written a fair number of programs that he discovered they were already available in the shops! Finally, he recommends that you buy the biggest machine you can afford: you are almost certain to need the extra capacity as you find more and more jobs you want to do on it.

The future

Tom's head is absolutely bursting with ideas for his system. For example, it

GOTO page 158.



COMPUTER ANSWERS

Send your queries to: Sheridan Williams, 35 St Julians Road, St Albans, Herts.

Adaptor wanted

I recently purchased a UHF modulator type UM1111E36 from Interface Components of Amersham. The modulator has a phone socket output and none of the shops I've been to can help me with an adaptor for connecting to a coaxial cable to a TV set. Where can I obtain a suitable adaptor?
Len Wood, Bourne End, Buckinghamshire

You should have no difficulty obtaining suitable plugs and sockets from Maplin at 159-161 King Street, Hammersmith, London W6, tel 01-748 0926, or 284 London Road, Westcliffe-on-Sea, Essex; in fact, any good electronics/radio shop should be able to supply you.
SW

Tools not toys

I am interested in statistical and other scientific calculations, but the Commodore PET with all of its advantages lacks arithmetic accuracy; my HP 33E calculator calculates to ten-figure accuracy. There are many of us who are interested in using micros as scientific tools rather than toys for playing Space Invaders — can you help on this point?
F M Eggert, London

Any piece of equipment that exists in as many varieties as do computers needs a well-written specification of requirements before a short-list of suitable items can be drawn up. The PET (together with many others) does have limited arithmetic precision. This is not a fault of the hardware but of the version of Basic provided. If a system was chosen that didn't have Basic in ROM it is much more likely that a suitable version of Basic could be found. There are machines that have a double precision capability *and* have Basic in ROM if this is important. Languages such as Fortran have a double precision capability built in and those variables that are required to have double precision can be so specified. Any system running under the CP/M operating system could use MBasic, which allows double precision. One of the cheapest systems that has double precision is the Video Genie.
SW

Cow PET

I am interested in using a computer as an 'electronic herd book' to store pedigree cattle identities, together with sex, date of birth and six physical measurements per animal (three-digit integers) so that one or more of the following analyses are possible:
1. List of parents and grandparents with measurements;
2. List of close relatives with measurements;
3. Comparison of measurements of contemporaries.

What kind of computers would be suitable, bearing in mind that I have no knowledge of electronics? This would be very much a 'hobby' development for me in the first instance.
I P Ross, Inverurie, Aberdeenshire

Well, I think this is one of the ideal ways in which to become familiar with computers and programming. You have in mind an application in which you know precisely what you want; it is simple and only requires a small system. You are also starting off by treating it as a hobby, which means that you probably won't be too upset if it takes longer to master than expected.

You have stated nearly as much as I need except for the maximum foreseeable size of herd. This is not of crucial importance as you will see later. You must look for a computer that has good file handling commands and, of course, which has a cassette interface; but let us look at the problem in more detail.

Basically, there are two ways in which we might want to process files — serially and randomly (directly). For the latter, a disk drive is essential, while for the former it is only essential if fast processing is required, otherwise a cassette deck will do. Your application can easily be done using serial files and it remains for you to determine what delay is acceptable before results are obtained.

The next thing to be aware of is that true file processing requires *two* cassette decks; this can be overcome provided you have sufficient main store, but in going for a low budget system you are almost certainly going to be short on main memory. It appears that each record will contain about 30 characters after coding and it is easy to work out the memory required for processing by multiplying the number of characters per record by the number of records (200 cattle will require 200 x 30 = 6000 ch; ie, 6k of memory). The calculated memory requirements must be over and above the amount used by Basic *and* your program, so you are unlikely to find an 8k system large enough. However, all this is irrelevant provided the computer supports twin cassette decks, *and* file commands to access both at the same time. Beware the salesman who will not commit himself on this point. Writing programs to cassette is simply not good enough.

The PET in its cheapest secondhand version with two cassette decks is certainly up to this task but make sure that you get both the cassette deck heads aligned because this is the most frequent cause of error when using two decks. Most micros read cassette files at around 30 ch/s, which means one record per second in your case. With 200 cattle, this will take just over three minutes to produce an answer. Updating the file will take around twice as long as you will have to wait for both reading and writing times for each cassette.
SW

Getting started

I have recently inherited some money and am considering starting up a software house for the TRS-80, but have no real knowledge on how to do this. In particular, I require information as follows:
1. The initial cash outlay before I can start;
2. The best way to obtain software;
3. What copyright laws I am bounded by;
4. What percentage royalties I pay;
5. How I make such payments;
6. The cost of advertising in *PCW*.
D S Webb, Colwyn Bay, Clwyd

Starting *any* kind of business requires professional advice. Certainly much more than can be given in a brief answer such as this. There are several books on the subject of setting up your own business and I suggest that this might be as good a starting point as any. I am sure that you are probably quite an expert in your own field and would realise that you will need expertise in several areas other than the pure computing side.

You are bounded by all the copyright laws, the same as any other person/company in Britain, but the whole area of computer software copyright is shrouded in uncertainties. You should avoid situations that are morally wrong, such as changing a few statements in a program and calling it your own. There has been a recent case where someone produced a program that would enable users of Visicalc to copy their disks; this can seem innocent or far-reaching, depending on the way you look at it. You pay whatever commission you agree at the time — this is up to you and the program supplier — and you make the payments in any way that you agree. Write directly to the advertising department of *PCW* for current advertising costs.
SW

Which one

As a newcomer to computing I have decided that, to learn as much as possible about the subject, it is essential to have my own computer. Three machines appear specially suitable for the beginner: the Sinclair ZX80, the Acorn Atom and the Newbury NewBrain. Could you please comment on these and suggest which would suit a beginner best?

If I want to expand at a later date, would this be possible or should I think of starting with something like a Video Genie? Guy Kewney suggested in your February issue that there could be some delay on the NewBrain. Would it be better to wait for this, or choose some other machine now?
J A Priam, Exmouth; Jan Kalin, Ljubljana; and M Shroff, London

Taking the last point first — the microcomputer market is still in a state of rapid development and those who wait before buying will have a wider choice and quite likely lower prices. On the other

hand, they will have let all that time go by when they could have been learning about computing 'hands-on'. And I do agree that's the best way to learn. So, if you can't get such practical experience at work, or from a school or college, and you've got about £150 to spare, you can get your experience at home; with the usual advantages of as much time as you like, and when you like.

There are at least two other computers to add to your list: the Sharp PC1211 Pocket Computer (or the Tandy version of it) and the Microtan. Of all these the Atom and Microtan offer ready scope to expand in steady stages to much more powerful systems with printers and disk drives. The NewBrain's spec probably offers scope for expansion, as it is very well provided with I/O features, the ability to cope with a lot of RAM, and with an increasable amount of ROM. But as yet there's no indication of when it will be available.

The Acorn has an unusual version of Basic — a strong point if you are a mathematician, a weakness if you want to learn Basic from it for later use on other machines. The ZX81 is a most intriguing item, having a number of features most helpful to the beginner, such as single keystroke entry of many commonly used Basic keywords and instant syntax checking as each line is entered. The Sharp pocket computer is just that, a computer operating in Basic, which is about the size of, and cheaper than, many programmable calculators. The penalty for the small size and low cost is slow operation in comparison with the other machines in question.

As regards expansion, this can be done, as I've said, without going to the expense of a Video Genie, although at about £320 VAT paid, that is also very good value for money.
P L McIlmoyle

Chess despair

I am in despair! I bought a Tandy TRS-80 4k Level 1 with the aim of programming it to play chess — the rest I leave to your imagination! I'm now having it upgraded to 16k level 2, and would appreciate your help over how to program it for chess playing. I expect that I will need a Z80 machine editor/assembler and/or a T bug but would welcome your guidance. If I need extra RAM, is this easily and cheaply available for the TRS-80 as it is for the ZX80?
R W Edwards, Tamworthy

You do not say in your letter whether you want to program your Tandy to play chess for the fun of the programming challenge, or primarily so that you can use it to play chess. If the latter is your real aim, then I am convinced that you would do much better by buying an effective chess-playing program ready-written rather than spending your money on system software. An effective chess-playing program represents many hundreds (if not thousands) of man-hours in writing it.

If you really want to go ahead with writing your own chess-playing program you will certainly want to use machine code for speed. So you should start by mastering the use of Z80 machine code on the TRS-80, using the USR function in level 2 Basic. Then the best bet would be to contact someone else working on the same problem.

Chess programs for the TRS-80 are available from A J Harding (Molimerx), from £14 to £26.
P L McIlmoyle



'It must be all those diet programs you keep feeding into it.'

Trig calcs

Would you please give me the equations by which Basic or any other compiler calculates values for sine, cosine, tangent, logarithm, etc. Why is there no routine for calculating factorials?
Phillip L Watson

Most people are aware that there are series that approximate to the functions sine, cosine, tangent and logarithm; the series for sine is:

$$\sin(x) = x - \frac{x^3}{3!} + \frac{x^5}{5!} - \frac{x^7}{7!} + \ldots \text{ valid for all } x.$$

There are similar series for the other functions. However, there is a major drawback with such series — you may have to take dozens of terms to obtain the correct answer. What we require is a series that gives you the correct answer in only a few terms. To get such a series we will have to accept a restriction on the range of validity for x; this is not too much of a problem because functions such as sine repeat themselves anyway. Here is a series for sine:

$$\text{sine } x = \sum_{k=0}^{k=3} a_{2*k+1}\, x^{2*k+1} \quad \text{ABS}(x) <= \frac{\text{pi}}{2}$$

where a_1 = 1.000 000 002
a_3 = —.166 666 589
a_5 = .008 333 075
a_7 = —.000 198 107
a_9 = .000 002 608
If you don't understand then ask a friend with a little maths knowledge (A-levels will do). If you were going to program it in Basic, then set up in an array values for A(1) A(3) A(5) A(7) and A(9) then, using a loop, accumulate the sum as follows:

```
FOR K = 0 TO 3
T=T+A(2*K+1)*X↑(2*K+1)
NEXT K
PRINT"Sine of";X;"IS";T
```

I hope you get the idea. Notice that ABS(X) must be <= PI/2; therefore, you will have to scale your values for x. Here are the series for:

$$\text{cosine } x = \sum_{k=0}^{k=5} a_{2*k}\, x^{2*k} \quad \text{ABS}(x) < 1$$

where a_0 = 1.000 000 000 000
a_2 = —.499 999 999 942
a_4 = .041 666 665 950
a_6 = —.001 388 885 683
a_8 = .000 024 795 132
a_{10} = —.000 000 269 591

Tangent:

$$\text{tangent } x = \sum_{k=0}^{k=6} a_{2*k+1}\, x^{2*k+1} \quad \text{ABS}(x) <= \frac{\text{pi}}{4}$$

where a_1 = 1.000 000 02
a_3 = .333 330 82
a_5 = .133 397 62
a_7 = .059 358 36
a_9 = .024 570 96
a_{11} = .002 940 45
a_{13} = .009 473 24

Natural logarithm (ln):

$$\ln x = \ln 2 \left[-0.5 + \sum_{k=0}^{k=3} a_{2*k+1}\, u^{2*k+1} \right]$$

valid for $2^{-35} < x < 1$

where $u = \dfrac{x - \text{SQR}(2)/2}{x + \text{SQR}(2)/2}$

a_1 = 2.885 390 072 74
a_3 = 0.961 800 762 29
a_5 = .576 584 342 06
a_7 = .434 259 751 29

Square root:

$$y = 0.25 * (w + x/w) + \frac{x}{(w + x/w)}$$

where w = k(x+b—d)
if 0.5 <= x < k
w = k(x+b) if k <= x < 1
where k = 0.57155;
b = 0.75787; d = 0.013857.
These formulae came from *Handbook for Computing Elementary Functions* by L A Lyusternik, O A Chervonenkis and A R Yanpol'skii published by Pergamon Press
SW

Our apologies to Mr L W Huson whose name was wrongly mentioned in connection with a Hewlett-Packard query (May PCW). Will helpful readers plese stop writing to him.

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PCW.7.81

ZILOG'S Z8 FAMILY

Andrew Stephenson takes an in-depth look at a versatile group of processors.

Few *PCW* readers can have failed to notice how busy every integrated circuit manufacturer of any size has been lately, bringing the benefits of VLSI to the masses. Meanwhile, largely hidden by the squads of glamorous 16- and 32-bit CPUs, some comparatively inconspicuous but very interesting microprocessors have been appearing, too.

For example, the Zilog range has quietly expanded: apart from the famous Z80 and the recent Z8000, there's now the Z8601. This has become the founder member of the potentially significant Z8 family of devices, of which 18 should be available by the time you read this. Since all derive from the Z8601, it seems sensible to examine that one first.

The Z8

The Z8601 is a true one-chip microcomputer, carrying enough ROM, RAM and I/O for quite demanding practical applications. In processing power it lies close to the Z80; though more 'byte-oriented' and lacking in automatically-repeating functions, it is more versatile in its architechture.

Its design has obviously benefitted enormously from the exercise which also yielded the Z8000. Many functions have been rationalised, especially those involving register operations. From the viewpoints of both the circuit designer and the programmer, it appears to have been soundly thought out. In no way should it be regarded as a 'cut-down micro'.

Unlike the Z80, the Z8601 is purely memory-mapped. Those 'ports' it does have are 'I/O channels' rather than logical entities manipulated by a separate addressing mode. As in the Z80, programs can extend to 64k but a distinction is drawn between 'program space' and 'data space' (my terms), so that, while 64k can be given over to program, another 62k can be given to data.

Of an internal file of 144 8-bit registers, no fewer than 124 are general-purpose accumulators for logical, arithmetical and test operations, in various addressing modes. They can even provide stack space. Sixteen of the remaining 20 are control and/or status registers, while the odd four are assigned to four ports whose 32 I/O lines can be reconfigured in many ways.

Mapped into the register space are several on-chip 'devices': a 'start-stop code' UART; two counter-timers connectable to various useful points including external pins; the four ports, with handshaking on three if required; six prioritisable vectored interrupts from a choice of eight sources — two from the UART, two from the timer-counters, four from ports.

Memory

Users of devices such as the 6800 should have less difficulty in accepting the Z8601 than Z80 devotees, who may have to adjust to the totally memory-mapped I/O structure. More thought-provoking is the way the memory is divided up — see Figure 1.

Of the two major memory blocks, one is designed as being for program, although there are commands for moving register contents into and out of both areas with equal ease.

The lowest 2k of program is held in on-chip ROM. In the Z8601, this would be factory-programmed; other versions allow physically external but operationally internal ROM to be connected, a feature likely to endear the Z8 family to small-scale users. The device automatically copes with the physical difference between on-chip and off-chip program memory, crossing the boundary without programmer effort. This applies equally to the stack, which can occupy registers or off-chip RAM.

By contrast, external data movements have their own set of commands, owing to the distinction drawn between the internal register file and external RAM. Although register addresses run from 0 to 255 (with a couple of gaps), and may be thought of as slotting into a 2k non-addressable space at the bottom of data memory, they do not really form part of the data area.

The problems of applying the Z8601 to practical systems have clearly been thought through carefully. Although external memory costs some I/O lines, losses have been minimised by an ingenious choice of configurations which at first sight is bewildering, but soon reveals the underlying logic. More than one configuration is possible, according to how large the additional memory needs to be. There is no conflict between memory requirements and those of the UART, timers, etc. Again, the CPU copes with all off-chip addressing automatically — provided the right pins have been used, naturally!

Peripherals

There are approximately four classes of peripheral, discounting add-on memory. The possible configurations are numerous but my impression is that Zilog has anticipated many real-life applications. Not only are the options useful but the handbooks do offer a clear description of how to achieve them.

Four 8-bit ports can be configured to provide a wealth of I/O options. In all respects — data, status, control — they are handled as part of the register file and can even be treated as accumulators in some cases. For the sake of clarity they are best summarised out of sequence:

— Port 3 provides four output lines and four input lines. These tend to be used for odd signals: handshakes for other ports, UART I/O, timer I/O, interrupt requests and so forth. Alternatively, the two nibbles can carry data.

— Port 2 is always available for any mix of 8-bit I/O, with or without handshake via port 3.

— Ports 0 and 1, loosely speaking, provide control and data lines for external memory, or they act as normal I/O, depending on the desired configuration. Port 0 gives two bidirectional nibbles, while port 1 gives one bidirectional byte. Again, these ports can be controlled by handshaking signals via port 3.

Each of the two 8-bit timer-counters has a programmable 6-bit prescaler. Both prescalers can divide the internal clock (running at one eighth the rate of the external 8 MHz supply) by any value from 1 to 64. If required, port 3 can drive one as a counter, as well as output an 'end-of-count' signal from either.

These choices, along with others which determine whether the timers loop continuously or make a single pass, whether they generate interrupt requests, whether they start or stop or restart and whether one of them provides the clock for the UART, are all set by software. Once started, the timers run independently of the CPU. The 8-bit counters (but not the prescalers) can be read safely at any instant.

Duplex serial I/O can run as fast as 62,500 baud without recourse to any off-chip hardware, although buffers would be advisable. The format supplied is the popular one start bit, eight data bits, two stop bits mixture, with the option of converting one of the data bits into an odd parity bit. Tolerance of frequency errors should be good because the receiver loses interest after only one stop bit.

Eight sources can generate requests for interrupts, of which up to six can be accepted and juggled into any of 48 priority orders, according to system

needs. All of this is controlled via registers.

Apart from the four edge-triggered port 3 input lines, requests can come from the UART ('receiver ready' and 'transmitter ready') and from both timers. Astute readers may be wondering how separate interrupts can arise from the UART *and* both of the timers, since one of the timers supplies the UART clock. Likewise, how can all four port 3 inputs give requests, along with the UART receiver? Answer: two pairs of those signals are mutually exclusive; one or the other of each has to be chosen, hence only six interrupts.

Interrupt vectors are held in the first 12 bytes of program memory. A simple procedure allows a choice between servicing interrupts sequentially, or allowing interrupts to be interrupted, although requests can also be polled.

'Softer' features

Given its instruction set, architecture, and 4 MHz internal clock, the Z8601 offers a serious challenge to the Z80. There are 231 command types. Zilog claims three addressing modes (direct, indirect, indexed) but the Z8's ability to address blocks of 16 registers, using a 'register pointer' and abbreviated addressing, is really a fourth.

If data already lies in a register — *any* working register — it can be operated on immediately, in combination with itself, or with constants, or with the contents of any other register. If the data lies in program or data memory, or must be moved out to either of those areas, simple 'load' commands will effect the transfer but there are no means whereby a move can be combined with value manipulation. However, since every register is an accumulator and all are equally well-endowed with processing abilities, this should inconvenience few users.

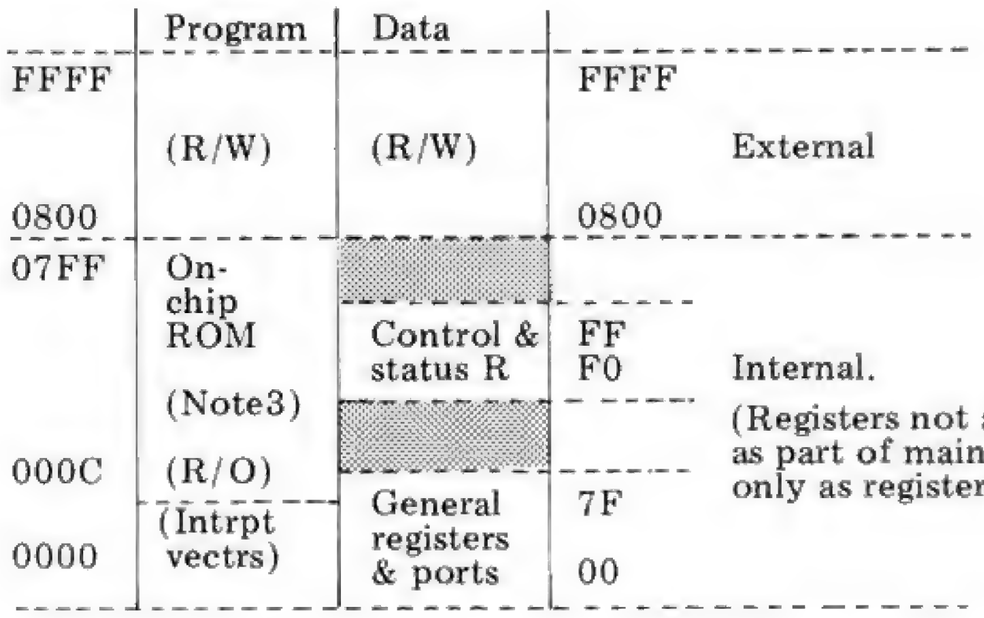
Value-altering commands include the fundamental arithmetical operations (add and subtract, with and without carry; clear; decrement and increment; decimal adjust; swap nibbles), logical combinations (and, or exclusive-or, complement, various rotations through carry, or not) and comparisons, along with two bit-masking tests which together outstrip the Z80 bit commands and of course there are the tests achieved using logical operations.

Although the Z8601 is as strong as most microprocessors on byte manipulation, there are only two commands for altering words: increment and decrement. Of course, this restriction is of no real consequence; any programmer worth tuppence an hour should be able to get around it.

More inconvenient is the lack of functions such as the Z80's LDIR, which will move a block of data by automatically-repeating transfers guided through pointers. The Z8 equivalents operate strictly across the division between registers and memory spaces and do no more than move a byte, then increment or decrement their pointers without repeating. There is also a lack of functions suitable for searching lists located outside the register space and none for automatic searches or strings for given characters. Minor though these nuisances are, they should be borne in mind.

The mention of a 4 MHz clock a few paragraphs up may not seem to jibe with an earlier mention of 8 MHz. Zilog confuses this question with its own documentation, which remains the weakest part of the whole Z8 package. The clock need consist of no more than a crystal with two small capacitors wired to two pins. Alternatively, one pin may be driven from a TTL supply. Frequencies up to 8 MHz are acceptable and will be halved for general internal use.

It should be appreciated that the official Zilog view of how the data memory divides is that external RAM and internal registers form two separate areas. While true from the standpoint of the instruction set, the two do not overlap and hence are merged in the diagram shown here.



Notes:
1. 000C is the program origin after a reset.
2. represents gaps in the register file.
3. The 'on-chip ROM' is replaced in some UPC devices by 36 bytes of bootstrap ROM, enough to oversee the loading of program into off-chip RAM which thereafter behaves as on-chip ROM.

Fig 1 Z8601 memory map.

Device type	Pack type	Min qty	£/unit: batch		1-off price
CPUs:					
Z8601 standard	40 dil Plastic	3000	£7	: 3000	n/a
Z8602 2716 pins	64 dil Ceramic	1	£24	: 100	£34
Z8603 protopack	40 dil Ceramic	1	£37	: 100	£52
Z8681 ROM-less	40 dil Plastic	1	£7.50	: 100	£10
Z8611, Z8612, Z8613 - 4k, similar to Z8601, Z8602, Z8603 - but uses 2732 (etc)					
Z8761 2k ROM Basic	40 dil Plastic	1	£23	: £100	£?
UPCs:					
Zxxx0 0n-chip ROM	40 dil Plastic	3000	£13	: 3000	n/a
Zxxx1 4k ext ROM	64 dil Plastic	1	£55	: 100	£77
Zxxx2 4k ext RAM	64 dil Plastic	1	£55	: 100	£77
Zxxx3 ROM protop	40 dil Plastic	1	£55	: 100	£77
Zxxx4 RAM protop	40 dil Plastic	1	£55	: 100	£77

Table 1 Z8 Family: Rough price guide, March 1981

There are two main divisions:

Z859x series — meant for use with 8-bit host CPUs;
Z809x series — for use with 16-bit CPUs.
Further subdivision arises from the choice of program memory organisation. The Zxxx0 are similar to the Z8611, in having an on-chip ROM for the program. Two other types, Zxxx1 and Zxxx3, are analogous to the Z8612 and Z8613 in offering two ways of connecting off-chip ROM. The remaining two, Zxxx2 and Zxxx4, contain pre-set ROM and a bootstrap program which allows the host CPU to download the UPC's program into RAM on 'reset'.

Zxxx0 standard — on-chip ROM	40 dil
Zxxx1 4k external ROM — 2732, etc	64 dil
Zxxx2 4k external RAM	64 dil
Zxxx3 ROM protopack	40 dil
Zxxx4 RAM protopack	40 dil

The RAM types meant to fit the protopack devices are:
2k : MSM 2128, OKI Semiconductors;
TMS 4016, Texas Instruments;
HM 611 P, Hitachi, CMOS.
4k : Z6132, Zilog, quasi-static, JEDEC pin-out.

Table 2 Z8 Family: Universal Peripheral Controllers

Pipeline

Figures for execution speed are further complicated by 'pipelining', not a Zilog diversification into plumbing but a trick for cutting computation time. Although no longer brand new, the implementation of this idea in the Z8601 illustrates the quiet revolution which the Z8 series represents. The notion is simple *in theory*: when all the values needed for

one instruction have been obtained by the CPU, the next set is fetched and put into a 'pipeline' so it will be ready for immediate use on completion of the current task. Several instructions may be stored. By and large, the programmer can ignore all this extra activity, although occasionally there is need for special care. Most instructions require six or ten internal machine cycles, while the slowest of all takes only 20, so the overall speed is comparable to that of the Z80A on simple tasks.

Addressing

In the Z8 family the addressing convention employed by the Z80 is reversed, so that now the high byte of a word is stored below the low byte. Compare how the two would store the hex word ABCD at address 1000:

	Z80	Z8
@ 1000:	CD	AB
@ 1001:	AB	CD

This is not sheer perversity on Zilog's part. There are advantages to the 'new' convention.

Zilog admits to three addressing modes, then makes a separate fuss about a fourth. With due respect to Zilog, I shall lump them together; then I shall describe two more:

Register Pointer Mode permits abbreviated addressing and is available in the majority of instructions. The register file is divided into groups of 16 registers, each group being identified by the high nibble of its hex address. One of the housekeeping registers, number 253 (or FD hex), acts as a pointer to the current working register group, in that its high nibble is combined with the single nibble supplied by the instruction to create the exact address. Thus, if register FD holds 6A hex and the instruction gives the value 3 hex, the register pointed to for use in the operation is number 63 hex. Programs which can call standard routines without needing to calculate absolute addresses can operate far faster, so this feature is of considerable importance.

The other three modes are also widely available:

Register Addressing will be familiar to every programmer since one particular register is designated by number. Either the number itself may be given (eg 63 hex), or Register Pointer Mode may be used. Some instructions imply a pair of registers, whose contents are to be used in combination. For example, INCW RR10 results in the word held in registers 10 and 11 being incremented. In such cases, the address must be an even number.

Indirect Register Addressing causes the register (or registers) designated by the instruction to be read; then the contents are taken as the address (of a register or program instruction, as applicable). This applies to virtually every operation which requires an absolute address, including jumps.

Indexed Addressing is slightly trickier. The instruction yields two values; one is the address of a register whose contents are added to the other value to yield the address of the register to be used in the operation. This mode is also widely available.

The fifth and sixth modes hardly require more than a mention:

Direct Addressing is used only for jumps and calls, where the exact target address is known.

Relative Addressing is the familiar form where the current program address is increased or reduced by the amount given in the instruction. This mode is confined to jumps and decrement then jump if non-zero.

Learning the language

The instruction set appears easy to learn, symbolically and functionally. Unhappily, Zilog has made a desperate mess of the notation used in its handbooks, in that there is a profoundly confusing inconsistency between assembler code mnemonics and the shorthand summaries given in the otherwise splended instruction descriptions. For example, @RR in Assembler is the equivalent of R in Summary. Furthermore, r in Summary equals Rn (where n is a value between 0 and 255) in Assembler. How Zilog dared inflict this garble on the world is a mystery; it runs a very serious risk of having someone else 'take over' the production of the explanatory literature which ought to be kept firmly in house.

That said, the official assembler code is uncomplicated and closely related to that for the Z80. Sadly, there as yet appears to be no equivalent to the useful *Z80 Technical Manual*. The closest Z8 publication, similarly titled and paperbound, concentrates on hardware details and confines itself to a very technical summary of the instruction set. Though much of this information will certainly be needed by programmers, it is a bit much to ask them to spend a further considerable sum on the *Z8 PLZ/ASM Assembly Language Programming Manual* of which only a minor part is given over to (excellent) explanations of instructions and mnemonics.

Current commercial situation

Eighteen versions of the Z8 already exist, many of them package variations aimed at different sorts of users. Table 1 gives a current general price guide for 100-off and one-off quantities other than devices factory-programmed to order.

Z8601 is the standard version, described above. Being factory-programmed, it will probably only appeal to large users. Like the majority of the family, it is supplied in a 40-pin DIL pack, in both ceramic and plastic versions.

Z8602, a 'development device', is functionally identical to the Z8601 and is supplied in a 64-pin pack whose pin-out resembles that of the Z8601. The 24 extra pins are direct connections to external ROM, such as the 5V 2716, and require no buffering. Because of these extra lines, up to 2 kbytes of program cost no I/O, although additions beyond this limit do, as does data memory.

Z8603 is a 'protopack' device intended for development applications where the pack must mimic the Z8601 as far as possible, even to board layout. To achieve this, it has a piggyback socket for a 2716 EPROM.

Z8681, called the 'ROM-less Z8', is a many applications will require off-chip memory anyhow, this device comes with just enough pre-set program to configure it for external memory. Thereafter, the user's software takes over. It is cheap, does everything a Z8601 with external memory will and should appeal to small users.

Three more types differ from the 2k Z860x series by containing 4k of ROM: Z8611, Z8612, Z8613. Obviously, there is no 'ROM-less' version here.

Derivatives

Zilog would have been foolish not to capitalise on the Z8's potential as a stand-alone controller of peripherals. Accordingly, it has produced ten 'Universal Peripheral Controllers'.

Every member of this sub-family is virtually a Z8 with one less port, no UART, no 'externally-addressable memory, an enlarged file (256 registers) and a very nice ability to chat to the CPU over an 8-bit bus (Zilog's own 'Z-bus' — very simple, very logical, easy to use, reminiscent of 6800 protocol). The CPU can be allowed two-way access to any number of registers, thereby speeding data exchange but if necessary the UPC can pull up the drawbridge and sulk. Some versions allow the CPU to load the UPC's program after a reset; RAM is substituted for ROM, the wiring differs slightly but otherwise all is the same. The main line of division lies between UPCs intended for use with the Z80/8080, etc (Z859x series), and those for the Z8000 (Z809x series). See Table 2 for details and rough prices.

Specials

Obviously, the Z8601 can be preprogrammed to do virtually any task appropriate to a small microprocessor. Again, Zilog has seized the advantage and has produced the Z8671, preprogrammed with a monitor and Basic, all in 2k.

However, though the Z8671 appears to be on sale, the information available is still 'preliminary'. Zilog spent about 30 minutes digging through a handbook 'half an inch thick', then said enough for me to guess that it's an unsurprising but possibly useful/amusing integer Basic. Otherwise the Z8671 is a normal Z8601, so can access additional external program. Clive Sinclair and his imitators could soon be selling one-chip computers, never mind these bulky ZX81s!

Future developments

One could speculate endlessly on what might be done with the Z8 and its derivates. Among the tangible developments which can now be ...entioned are faster versions of all these devices, probably to be identified by the suffix 'A', which will have a maximum external clock speed of 12 MHz. On byte-level tasks this should push the Z80A firmly into the league below and even the Z80B will have to look to its laurels.

The outcome of such 'contests', of course, depends on those who find applications for this new family. People like you, the reader.

Our thanks to Zilog (UK) Ltd for its help in the preparation of this article.

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YOUNG COMPUTER WORLD

Compiled by Derrick Daines

Computer games

I've been speculating recently on what it is that makes a good computer game and I thought that, with so many of you sending in programs, you might be interested in my conclusions.

At first sight, there doesn't seem to be much connection between games other than the fact that they're played on a computer. For instance, what possible points of similarity are there between — say — Space Invaders on the one hand and Adventure on the other? Space Invaders is all real-time graphics while Adventure has no real-time element and is all text.

Instead of looking directly at the problem of what makes a good computer game, however, it helps if we look at and analyse those computer games that are not so good — are there elements that we can say detract from their value?

Yes, I think that there are and if you thought about it for a bit, you might come up with similar answers.

One thing that poor games do not do is involve the user enough. There have been several very clever games that have gone across my desk that were minor miracles of programming but when you ran the programs there was little for you to do except sit back and admire. This is a game? Nobody wants a game like that; we want to be doing something — participating — making things happen. Space Invaders does that, all right — every split second.

Many games lose their interest after about 30 seconds because they are too easy. They conjure up the image of Charlie Chaplin yawning and casually polishing the fingernails of one hand while bopping a queue of blundering idiots who persist in charging through a certain door — they never learn and knocking them down gets boring. To be successful, a game has to present a real challenge.

There are challenges and challenges, of course. A game that is challenging for an adult might be so incomprehensible to a child as to be pointless. (I know of no child who is as hooked on running the economy as I am!) The age-range aimed at must therefore be clearly thought out — and a game that will appeal to all ages is about is common as snowballs in the Sahara. This is true for any kind of game, not just those run on a computer.

These thoughts help to get us started. One thought that came to my mind was that good games have a bit of a 'bite'. That is to say, they're a sort of stylised warfare in which you do your damnedest to do down the other fellow without lasting damage. Take Monopoly, for instance, the biggest success story among modern games. Or chess, among old games. You 'do' your opponents and you feel cross or self-critical — or murderous! — if you lose.

I think that good computer games have this element, too. In Space Invaders, I suspect that most players are not murderous towards the little jiggling, stupid, advancing green men. No — I suspect that players have in the forefront of their minds their mate's best score, and it is this they are trying to better — and through it, him/her.

I can accept that many people won't feel this way but are simply bettering their own scores, in which case, the person they are trying to 'do better than' is themselves. They are trying to improve some skill — which brings in the next important element of a good game. Does it exercise some skill? Can you get better and better at the game, or does it rely too much on chance?

A good test of this skill factor is to enquire if you can do worse if you deliberately neglect to exercise your skill. I throw this one in because one computerised version of Dungeons and Dragons I saw upgraded the player as he progressed through the game, to such an extent that he was virtually invincible. We're back to that image of Charlie Chaplin again. The program writer wrongly thought of increased skill as a reward rather than something earned and maintained by effort, something unique to the player.

Lastly, D & D reminds me that there is an element of imagination or even fantasy in a good game. I don't think this needs stressing, as most people are well aware of it and indeed, it is probably the most obvious point of all.

There we are, then — my recipe for a good computer game: 1. Involve the player as much as possible. 2. Give the player a real challenge. 3. Give the game a bit of a bite — the chance to do opponents down, even if the opponent is yourself or the computer. 4. Involve the exercise of skills — manipulation, thinking, observing, analysis, computation — anything at all. 5. Exercise the user's imagination in some way.

Now you should all be able to write superb games programs and send them in to *PCW* when you've done it! (How's that for a challenge and the exercise of skills?)

Programs received

Decimal-to-Binary Converter and Noughts and Crosses (Hewlett Packard 9830A), by Michael Bissett (15) of Glenrothes, Fife.

Space Wars (TRS-80) by Richard Acland (13) of Colchester.

Die Rolling/Betting (ZX80) by Adam Brown & Simon Holmes of Bicester.

Maze for PET, by A Esmond (14) of Scarborough.

Pontoon for ZX80 by D J Ford (12) of Chepstow.

Drawing on TRS-80 by Robin Gardner (14) of Bedford.

ZX-80 Maths Test, by Stephen Bootes of Hartwell, Northants.

Random Lines (TRS-80) by Mark Claydon (15) of Harrow.

Breakout (Microtan 65) by Peter Simpson of Wivenhoe, Essex.

Well done, all of you! You can't send too many.

Commercial break

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End of break

Would the author of the ZX-80 Adventure Maze please write in? I don't have your address. Oh, and would you all please put your name and address on your tapes *as well as your letters?* It gets to be quite a headache matching one with 'tother. Thanks a bunch!

Mugtraps

My Mugtrap Award this month (a stupendous book-token) goes to Richard Vernon (15) of Uxbridge, who sent this in for the Acorn Atom:

```
220 (end of main program)
221 P.$21
230 (JSR #FFE3;STA #81;RTS;)
235 P.$6
240 P.''WOULD YOU LIKE
        ANOTHER GAME'' ''
250 P. ''HIT KEY Y OR N''
270 LI.#82
280 IF ?#81 = CH''N'' T.E.
290 IF ?#81 = CH''Y'' T.RUN
300 P.$7;G.250
```

That's nice. If you can follow Acorn's peculiar Basic, you will see that the mug does not have to press RETURN at the end of a program. He just taps Y or N, but if he does neither, he is looped to line 250 over and over until he does.

A little reminder to all of you that I'm interested in mugtraps and I'll give book-tokens for any published on this page. Roll 'em in! This is a terrific way that we can all learn from each other.

PATTERNS

Alan Sutcliffe continues his thought-provoking series.

Generating patterns is intrinsically satisfying, but it also has many applications. I find it particularly pleasing to enumerate all possible patterns of a particular kind. This is also useful in the analysis of many games and pastimes. Having written in the last two months about ways of generating complete sets of patterns, I am now going to turn to their use in the study of games.

State diagrams are the subject of this article. In the first half I give some examples of their derivation and use and in the second part some programs are presented for manipulating state diagrams. This is interspersed with some general remarks.

Any game that can be played on a computer can only have a finite number of positions or states. This number may be very large and unknown (as in the game of chess) but nevertheless limited. The number of different positions in chess is certainly less than 65^{35}, since each of the 32 pieces must be on one of the 64 cells or off the board. This is a gross overestimate, since no two pieces are allowed to be on the same square. A somewhat better upper limit is 65!/33! although this counts pawns as distinct. Some other restrictions are also ignored, such as impossible positions and symmetrical cases. There are at least 64!/50! different positions — the number of ways of placing one piece of each kind and colour on the board. But the numbers hardly matter: the point is that they are finite.

Many other games have a more modest number of possible positions but even for quite simple games the number can be fairly large. In noughts and crosses, for example, even allowing for rotations and reflections, there are many hundreds of different states that can occur in the course of a game.

A state diagram is simply a list of all the possible positions that can arise in a game or other activity, together with details of all the links that lead from each position directly to the next. A path through a state diagram is a series of one or more links from one position to another. If the diagram represents a game, then one complete instance of playing the game will be represented by a path from the starting position to an end position. I will illustrate the use of a state diagram to solve a little puzzle that I call Oppo.

Oppo is played with five numbered counters arranged in a ring. A move consists of taking any counter and moving it to a position at the opposite side of the ring, as shown in Figure 1. The order of the counters round the ring is all that matters, not their exact location: the counters do not fit into fixed cells. For convenience, arrangements will always be shown with 1 at the top. The following questions can now be asked and answered:

1) From a given starting position, is it possible to reach all the other positions?
2) Of those that can be reached, what is the fewest number of moves needed to get to each and, in particular, which position is furthest away, having the longest minimum path to it?

The first job is to list all the possible positions. These are simply all the cyclic permutations of the digits 1 to 5. There are just 4! = 24 of these, since 1 may be taken arbitrarily to be in the first place followed by all the arrangements of the remaining counters.

The second task in deriving the state diagrams is listing all the links from one position to the next. In each state of Oppo there are just five possible moves: one for each of the five counters. This listing may be done in an organised way simply by taking the states in order and noting for each the states to which it can lead in one move. The result is shown in Figure 2.

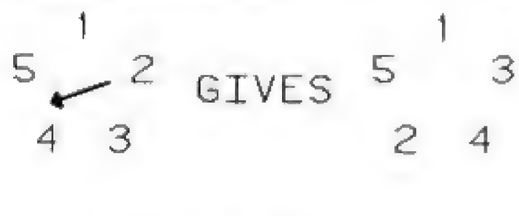


Fig 1 A move in Oppo.

This can be seen as an icosahedron, one of the five regular solids of Euclid. It has 12 vertices and 20 triangular faces. Inspection of the diagram allows us to answer the questions asked above:
1) From any position, only 11 other positions can be reached. The remaining 12 positions form a disjoint set with an exactly similar state diagram;
2) Of the 11 positions, five can be reached in one move and another five are two moves away. The final position, which is an exact reversal of the first and at the opposite vertex of the icosahedron, can be reached in three moves.

There is nothing special about the arrangement 12345 that we have chosen to start with, except the way we happen to have numbered it. Each of the other positions is equivalent. The regularity of this state diagram is attractive; notice that there are just 20 ways in which the sides of a triangle may be numbered with the digits 1 to 5, all the digits different on a triangle; each of these 20 ways occurs just once when each link of the diagram is numbered with the counter that is moved.

Here is an elaboration of Oppo that you may care to analyse. Call it Poop. The five counters are now placed in the frame of a rectangular 2x3 grid, as shown in Figure 3. Any counter immediately next to the empty cell may be moved into it. In the example shown 1, 3 or 5 may be moved. If one of the corner cells is empty, then only two moves are possible. Arrangements which differ only by rotation through 180 degrees, like those in Figure 3, are considered identical. There are no other symmetries to be discounted.

The state diagram is very much bigger. Since absolute position now matters, as well as the position of the blank

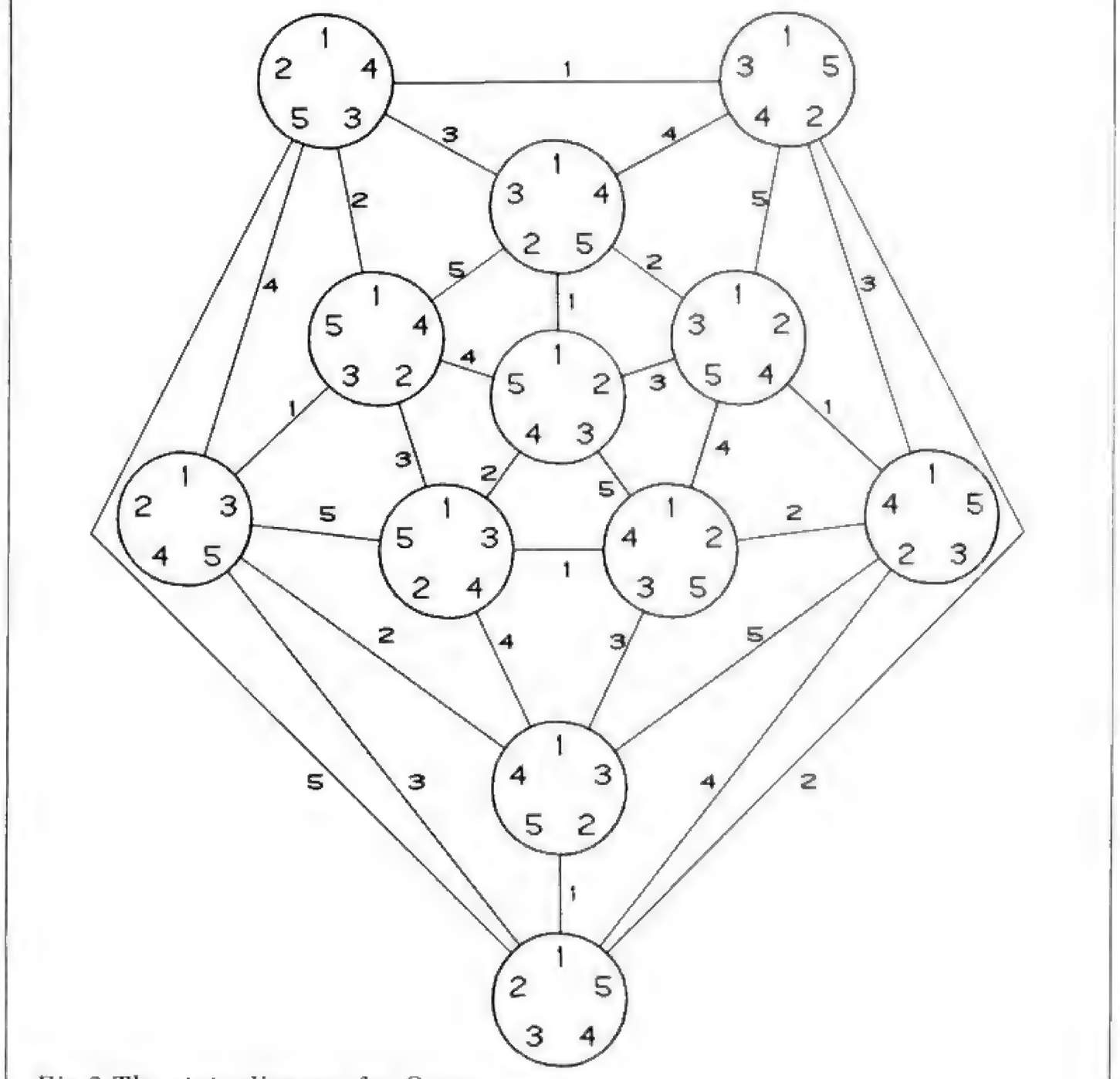


Fig 2 The state diagram for Oppo.

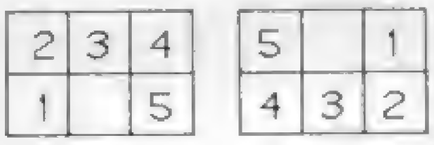


Fig 3 Identical positions in Poop.

cell, there are 24x3x5 = 360 different states. But the state diagram is still very regular: it is shown in Figure 4, with a close-up of a portion of it in Figure 5.

There are two essentially different kinds of move. When a piece is moved between the two middle cells — as in the move of 3 in Figure 3 — the cyclic order of the counters is altered, as with moves in the first puzzle. For all other moves the cyclic order of the counters is not changed; a counter is simply moved one place round the perimeter of the board.

The states thus fall into groups of 15 which all have the same cyclic order. Each single state in the Oppo diagram is replaced by such a cycle of 15 states. At every third state round each cycle, a move is possible into another cycle, corresponding to the moves in Oppo. The whole state space again falls into two disjoint parts, now with 180 states in each part: 12 cycles of 15 states. It can take up to 21 moves to get from one state to another in Poop.

Consider the following game for two players: starting from any position, the players move alternately; a move is defined as before; the first player to move into a position already used loses (Pooped).

There are two distinct ways to play the game — let's call it Poppo. The first is using a box of six cells and five counters, writing down a list of

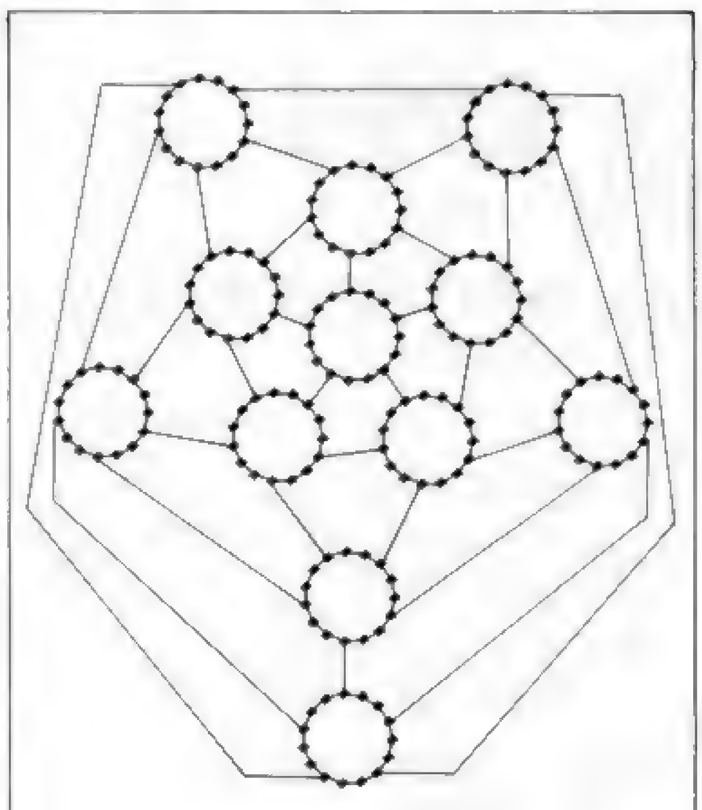


Fig 4 State diagram for Poop.

positions used as the game proceeds, so that any repetition can be noted. The second is to trace out the route of successive moves on the state diagram. The two methods give two entirely different views of what is logically the same game. In the first it is very difficult to see ahead and to remember the positions already visited. In the second, the past, present and future of the game are all relatively easy to see. The difference is like that between navigating an unknown maze with only pencil and paper and going round it with a map and compass. The game, if it does

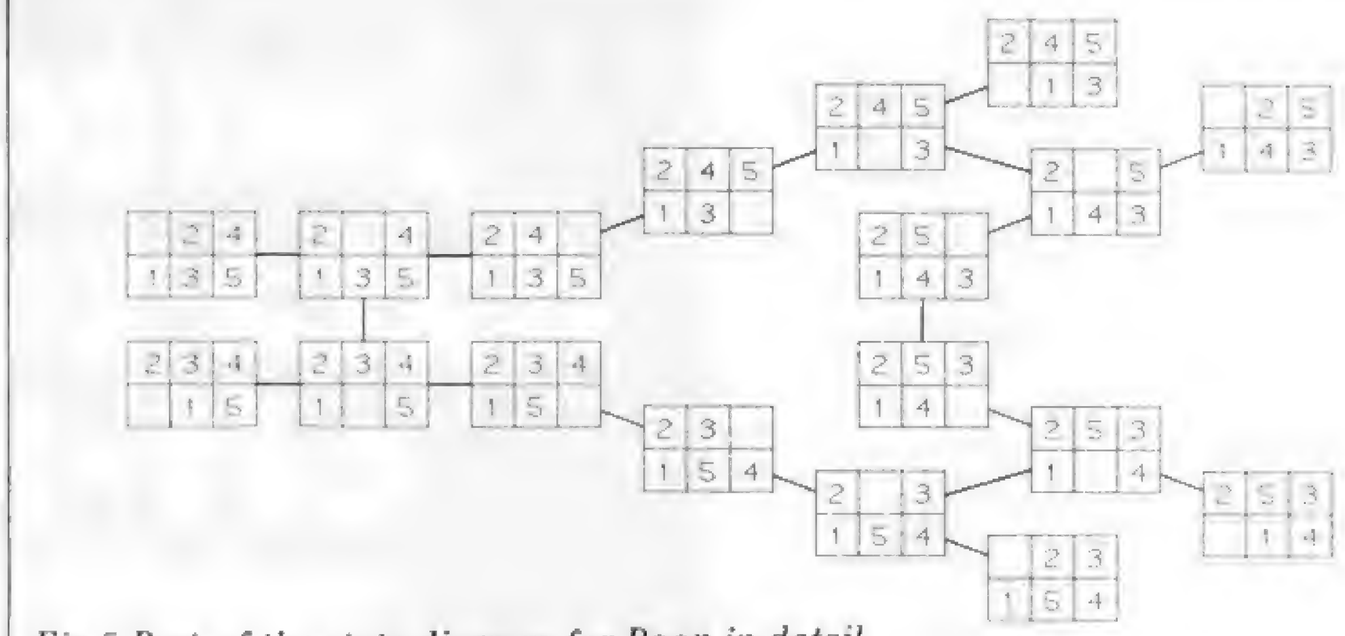


Fig 5 Part of the state diagram for Poop in detail.

not altogether lose its interest, certainly loses its mystery.

Notice, however, that the state diagram we are traversing is not the state diagram of the game Poppo but of the puzzle Poop, as shown in Figure 4: call it S_O. This has become the game board for Poppo, which has a far more complex state diagram, say S_P. Each state in S_P represents a path in S_O from the chosen starting position to some other position. S_P has as many states as there are paths in S_O from a given cell to any other cell without visiting any one twice. Plus, to be accurate, one state for each path in S_O that ends with the one repetition that terminates the game. State diagrams can always be used as a game board in this way, with an order of magnitude increase in the level of complexity. Since the aim of describing Oppo was to give a simple example, I will leave further investigation of this proliferating example to you and turn to another game with a less regular state diagram.

It is a simple game of the Nim type — let's call it Min. It is played with eight counters, set out initially as in Figure 6 on the corners and sides of a square. The rules of Min are: there are two players who move alternately; a move consists of removing one, two, or three counters with these conditions — any single counter may be removed, any two counters not part of a part of three counters in a line may be removed, any three counters in a line may be removed. The player who takes the last counter wins.

There are 17 different possible states of the board in Min, including the final empty board. I have enumerated these by hand and they are shown in Figure 6. Many arrangements with different appearances are identical as far as the rules of Min are concerned. State E in Figure 6, for example, consists essentially of three counters in a line plus any other three counters that do not form another line of three, either by themselves or with one of the counters in the first three.

There are $2^8 = 256$ apparently different states which reduce to the 17 cases given. Figure 6 also shows the links (moves) between states. There are two main ways in which the information in this state diagram can conveniently be coded into data for a Basic program. In the first method, for each state there is a list of states to which it can lead in one move. The last state should be marked as win, lose or draw for the player to reach it. In the second method, the information is coded into a matrix with one row for each state as a destination for a link. Notice that links are directed and A to B is not the same thing as B to A. Figure 7 shows part of the data for Min in the first form and the whole matrix for the second method is shown in Figure 8.

The first method has the advantage of needing less space than the second. The code needed to process it is a little more complicated, but in the second method time is wasted inspecting empty cells in the matrix. The second method has the advantage that it can be read both forwards and backwards, while the lists only give the forward links explicitly. All these factors should be considered in choosing the method to be used in a particular case, together with the constraints of the particular machine. If the state diagram is dense with links — many or most states can be reached from a given state — then probably the matrix is preferable, but if the matrix of links is sparse then the system of lists is likely to be better.

I shall now detail some useful processes that can be applied to the state data. The first is to find the total number of possible games. Program A gives this for the matrix data. The algorithm goes like this: establish a count for each state and set all these counts initially to zero. There is just one partial game for the initial state: the board set up and no moves made. Set the count for the initial state to 1. For each state which has had its count computed, starting with the initial state, add its count to the count for each of the states to which this state directly leads. When this has been repeated for all the states, the total number of games will appear as the count for the final state.

This method also works when there are several starting positions or finishing positions. Care must be taken to ensure that all the links leading to a state have had their count added to its count before that is added to those of its successors. Program A does not check for this but assumes that the states are in order of their occurrence in the game. This is easily achieved in any game like Min where one or more of the counters are removed from (or added to) the board at each move until some limit is reached. Simply list the states in order of the number of counters present. All Nim games are in this category as well as many cards games, such as whist, where a card must be played at every turn. Noughts and crosses has the same property, as does Othello or reversi. There cannot be a

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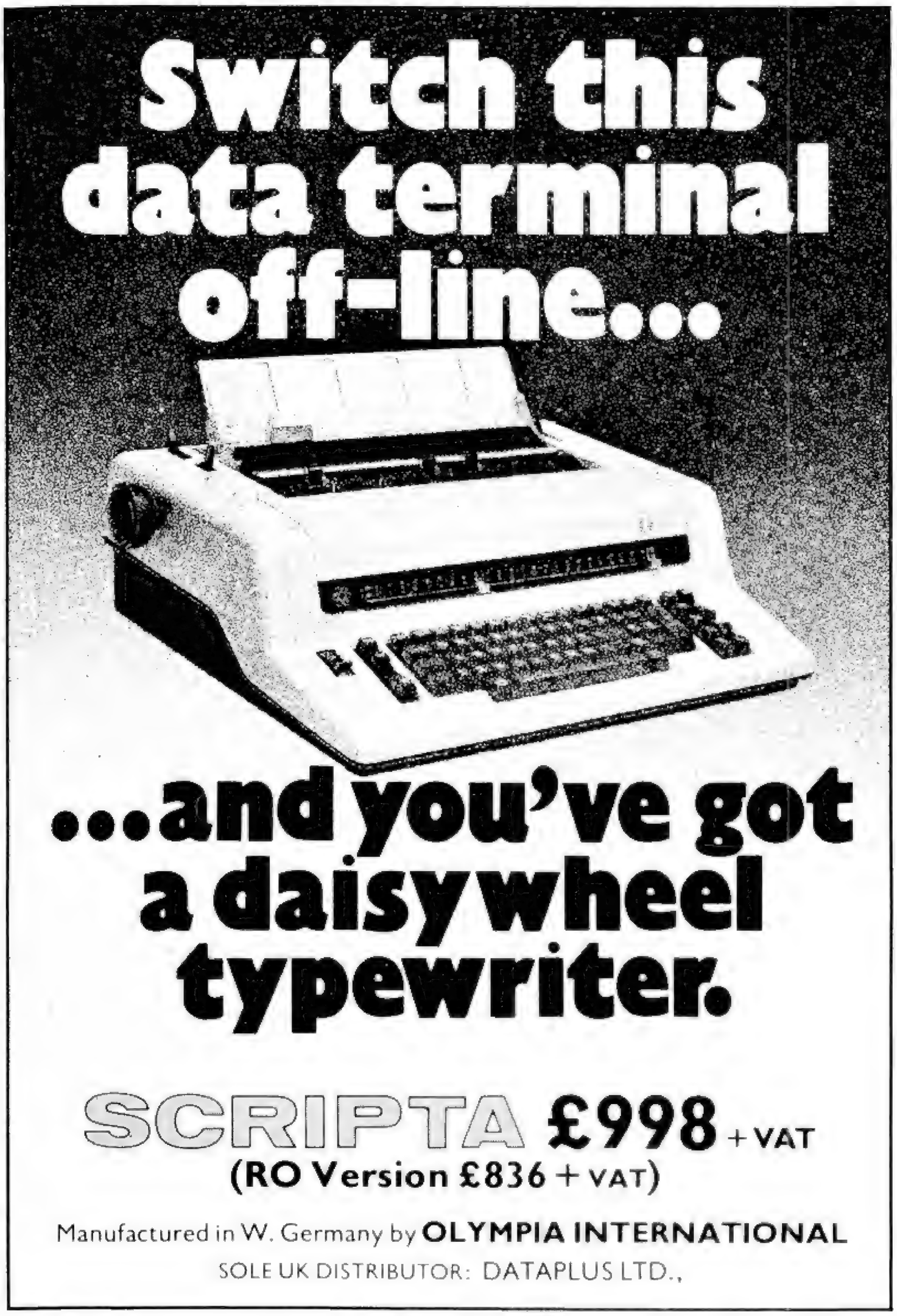
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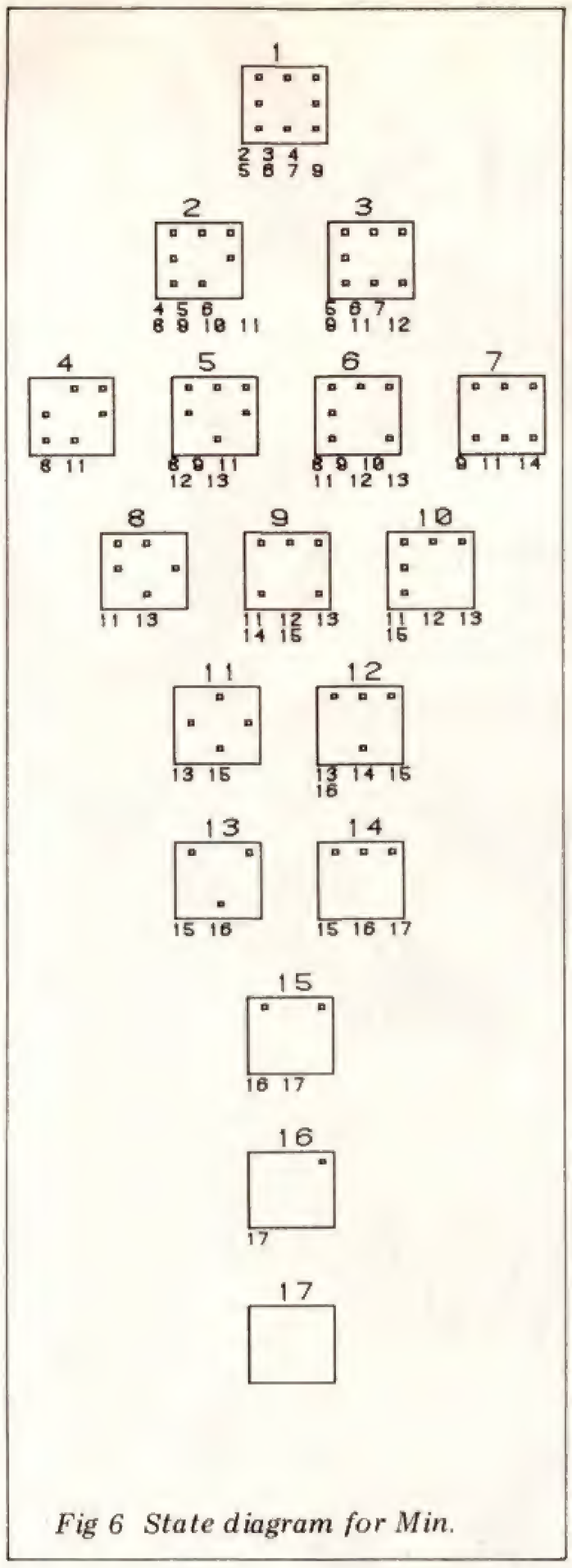


Fig 6 State diagram for Min.

link between two states with the same number of pieces played.

This property also ensures that another condition is met which is necessary for the number of games to be finite and therefore countable. That is that there be no loops in the state diagram and no sequence of links that loads from a state back to itself, so that no state may be repeated in a particular game. Since infinite games are hard on the players, any game with loops in the state diagram should have a limiting rule. In chess, this is that the game ends on the third visit to any state.

Beggar-my-neighbour is a game that looks as though it can go on for ever, though it seldom does. With some limited packs of cards, there is a loop in state diagram. Suppose that the first player has nnJn and the second has just Jn, where J is a Jack and n is any number card from 2 to 10, and it is the first player to play, these cards being face down from the top. Then, after three cards have been played, the position will be reversed, Jn against nnJn, to play. The game will thus continue to oscillate between these two states indefinitely. I am not sure whether this can happen with a full pack of 52 cards initially divided equally, which is the usual way the game is played. Beggar-my-neighbour has an unusually simple state diagram. For any

Number of links	Links						
1	7	2	3	4	5	6	7	9
2	7	4	5	6	8	9	10	11
3	6	5	6	7	9	11	12	

I	N(I)	V(I,J)
16	1	17
17	0	

Fig 7 Part of the state diagram for Min as lists

initial allocation of the cards there is only one possible game. The sequence of moves is entirely determined, since each state leads to only one other state. The interest is in the unknown, though predetermined, outcome of each game.

Now we come to the most important part of game analysis: how to win. In any game, like Min, for which the state diagram is known and the outcome is always a win for one player (no draws, ties, or stalemates), it is always possible for one player to ensure a win, whatever the other player does. To find out how to do this means establishing each state of the game as Safe or Unsafe for the winning player.

Safe (for the player) means a position from which the opponent must always move to an Unsafe position. Unsafe (for the opponent) means a position from which the player can always move to a safe position. Which state is which is determined by starting at the end and working backwards through it.

It is as though the state diagram is divided into small safe islands surrounded by an unsafe sea. The islands are so spaced that, stepping from one island, the opponent cannot reach another in a single move, but must land in the sea. And from any such position in the sea, the player can always get to the next island. The final position in Min is Safe: landing there ensures a win. Thus,

FROM \ TO	1	2	3	4	5		16	17
1	0	1	1	1	1		0	0
2	0	0	0	1	1		0	0
3	0	0	0	0	1		0	0
						M(I,J)		
16	0	0	0	0	0		0	1
17	0	0	0	0	0		0	0

Fig 8 Part of the state diagram for Min as a matrix

any state with a link to it is Unsafe. The next step backwards is to find any Safe state, ie, any state that is linked only to states already categorised as Unsafe. Given a set of Unsafe positions, as just found, there must be at least one Safe state which is linked only to them. This is true under the conditions already given and provided that the state diagram is finite. This process is repeated for further generations of Unsafe and Safe states until the starting state is reached. If this is Safe then the first player to play can always win and if it is Unsafe the second player can always win.

Program B takes the state diagram for Min and determines the Safe and Unsafe states. It can easily be adapted for other state diagrams.

In more complex games there may appear to be many starting and ending positions, but this can be simplified. There is only one starting position, the blank board. If the first player has the choice of initial position, this is taken as the first move, even though it may be different in kind from the other moves. There are only three end states: first player wins, second player wins, and drawn game. In noughts and crosses, for example, there are many distinct states which count as a win for 0, the first player. Introduce a nominal last move for X, the losing move, which consists, say, of changing all Xs to 0s. This is then the one state to which all the losing states for X lead. It counts as Unsafe (for X) so that all the states leading to it, the normal end states for the game, become Safe (for 0). All the winning states for X can be treated in the same way, and a third new end state introduced to tie together all the end states corresponding to a drawn game.

To determine the game, first trace the Safe/Unsafe states back from the 0-wins state, using the method given above. If the process reaches the start state then 0 can always win whatever X does and no further analysis is needed. But it may be that the process will peter out: at some stage from a set of Unsafe positions there will be no Safe position which leads only to Unsafe ones. 0 cannot win such a game, assuming that X always plays as well as possible. In this case repeat the analysis, starting with the X-wins state. This will show either that X can always win, or that the game must end in a draw, given as always that both players adopt the best strategy.

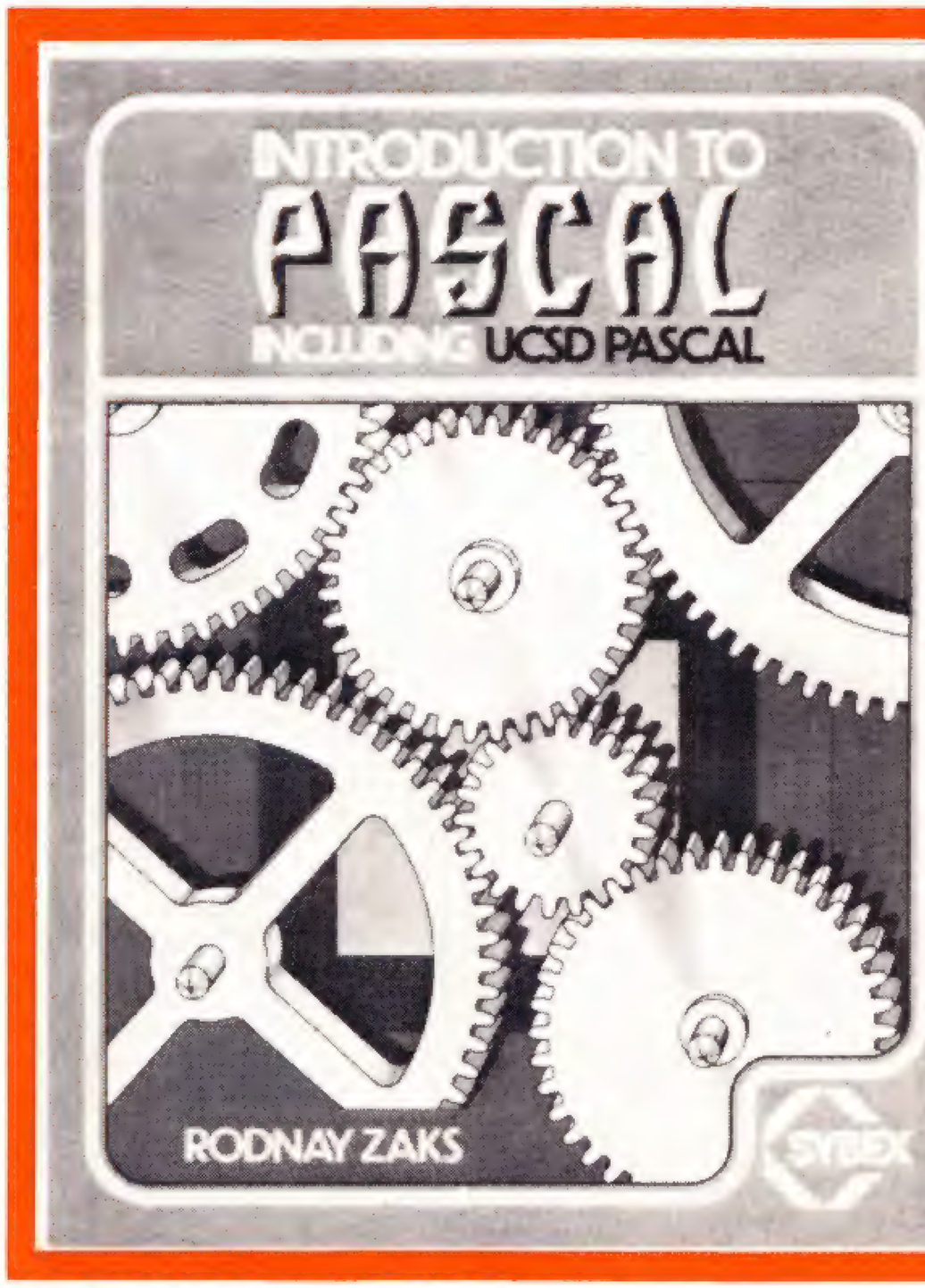
Another use for state diagrams is in programs that learn to play a game. For each move between two states there is a weight which gives the relative probability of choosing that move from the possible ones from that position. Thus, the matrix of weights has the same dimensions as matrix of moves (or as the lists of moves, if that method of representing the data is being used). Each time it is the computer's turn to move it selects at random from the possible moves according to the weights. Initially, all the weights are set equal, so that the computer plays entirely at random. Even when it is only one move from winning, the program does not prefer the winning move above the other possible moves. In that sense, it knows nothing about how to play except what moves are allowed.

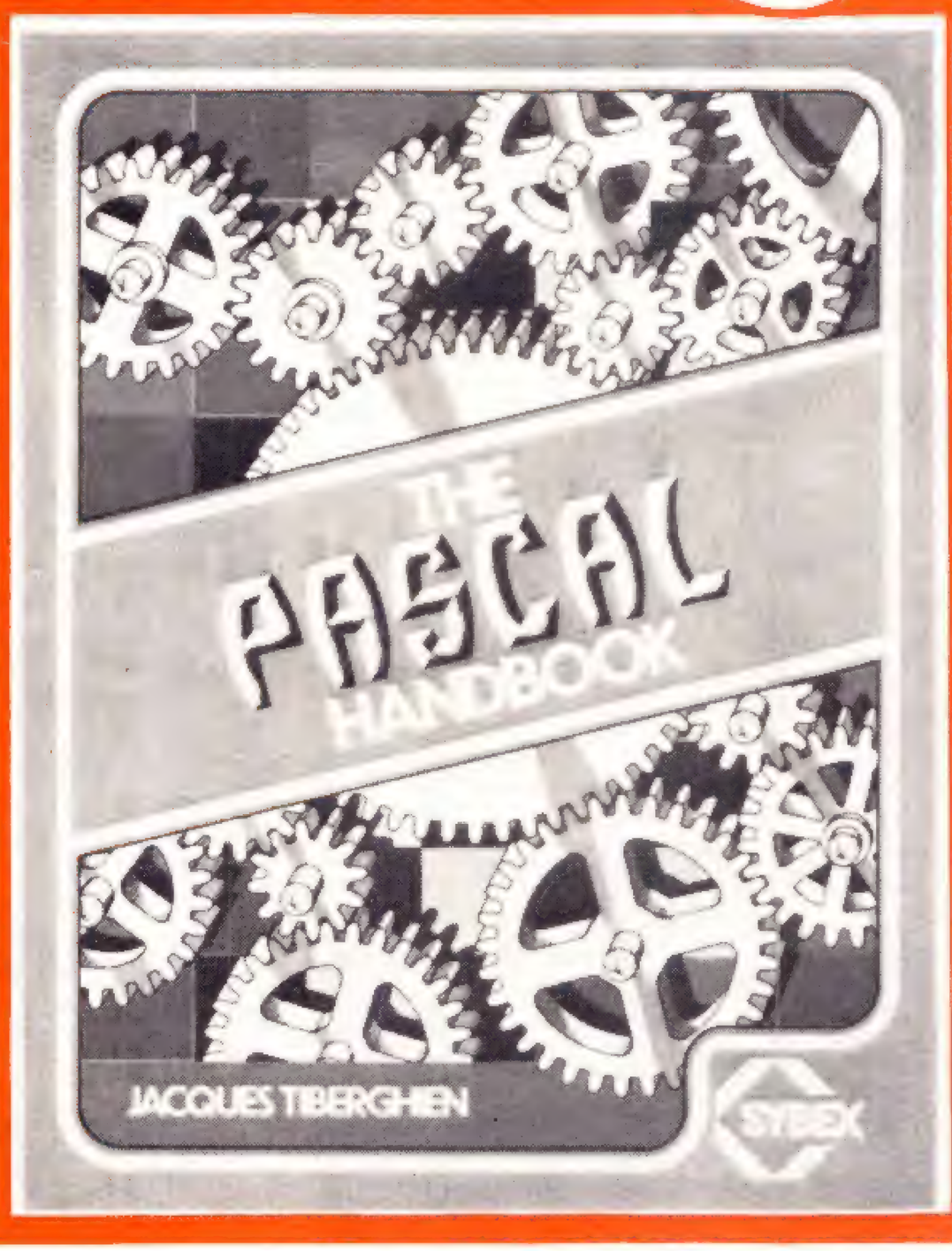
Each time a game is played, the weights for the moves taken are adjusted. If the computer won, the weights are increased, improving its chances of following the same path again. If it loses, they are decreased. The amount of change is open to fine-tuning. The weights for moves near the end of the game should be altered more than those near the start. A move at the end which leads immediately to a win can be weighted 100 per cent and the other moves from that state ignored in future. The program will then learn quickly how to do well at the end of the game. A move near the beginning which

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```
100 INIT
110 DIM M(17;17)
120 DIM C(17)
130 DATA 0,1,1,1,1,1,1,0,1,0,0,0,0,0,0,0,0
140 DATA 0,0,0,1,1,1,0,1,1,1,1,0,0,0,0,0,0
150 DATA 0,0,0,0,1,1,1,0,1,0,1,1,0,0,0,0,0
160 DATA 0,0,0,0,0,0,0,1,0,0,1,0,0,0,0,0,0
170 DATA 0,0,0,0,0,0,0,0,1,1,0,1,1,1,0,0,0
180 DATA 0,0,0,0,0,0,0,0,1,1,1,1,1,1,0,0,0
190 DATA 0,0,0,0,0,0,0,0,0,1,0,1,0,0,1,0,0
200 DATA 0,0,0,0,0,0,0,0,0,0,0,0,1,0,1,0,0
210 DATA 0,0,0,0,0,0,0,0,0,0,0,0,0,1,1,1,0
220 DATA 0,0,0,0,0,0,0,0,0,0,0,0,0,1,1,1,0
230 DATA 0,0,0,0,0,0,0,0,0,0,0,0,0,0,1,0,0
240 DATA 0,0,0,0,0,0,0,0,0,0,0,0,0,0,1,1,1
250 DATA 0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,1,1
260 DATA 0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,1,1
270 DATA 0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,1,1
280 DATA 0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,1
290 DATA 0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
300 READ M
310 FOR I=1 TO 17
320 C(I)=0
330 NEXT I
340 C(1)=1
350 FOR I=1 TO 16
360 FOR J=1 TO 17
370 IF M(I,J)=0 THEN 390
380 C(J)=C(J)+C(I)
390 NEXT J
400 NEXT I
410 PRINT C(17)
420 END
```

Program A

```
100 INIT
110 DIM M(17,17),S(17)
120 DIM T(17)
130 DATA 0,1,1,1,1,1,1,0,1,0,0,0,0,0,0,0,0
290 DATA 0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
300 READ M
500 FOR I=1 TO 17
510 S(I)=0
520 NEXT I
530 A=0
540 FOR I=1 TO 17
550 IF S(I)<>0 THEN 630
560 FOR J=1 TO 17
570 IF S(J)<>0 THEN 590
580 IF M(I,J)>0 THEN 630
590 NEXT J
600 A=A+1
610 S(I)=1
620 T(A)=I
630 NEXT I
640 IF A=0 THEN 730
650 FOR X=1 TO A
660 J=T(X)
670 FOR I=1 TO 17
680 IF M(I,J)=0 THEN 700
690 S(I)=-1
700 NEXT I
710 NEXT X
720 GO TO 530
730 FOR I=1 TO 17
740 IF S(I)<0 THEN 770
750 PRINT " SAFE  ";I
760 GO TO 780
770 PRINT "UNSAFE ";I
780 NEXT I
790 END
```

```
UNSAFE 1
UNSAFE 2
UNSAFE 3
 SAFE  4
UNSAFE 5
UNSAFE 6
 SAFE  7
UNSAFE 8
UNSAFE 9
UNSAFE 10
UNSAFE 11
UNSAFE 12
 SAFE  13
UNSAFE 14
UNSAFE 15
UNSAFE 16
 SAFE  17
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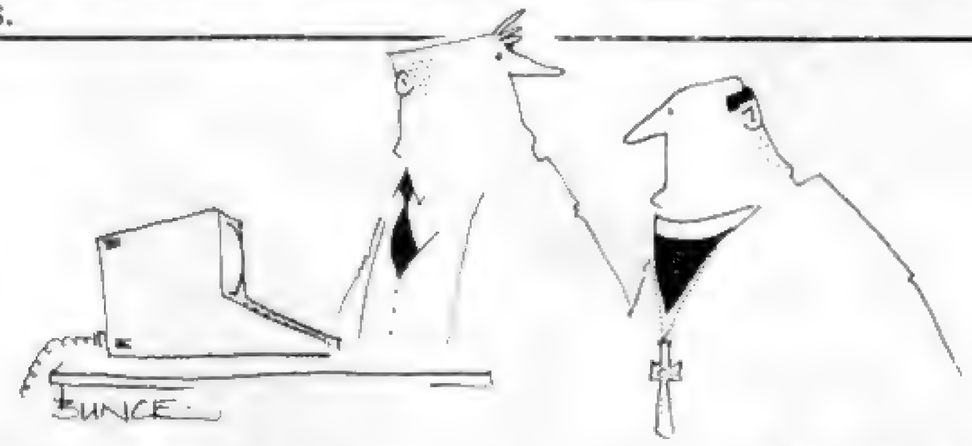
Program B

is on a winning route may also be on several losing ones. It should not be ruled out too quickly as the program cannot learn fully what to do at one stage of the game until it knows more about what happens later. In this way the learning process and the backwards search for Safe positions are very similar.

It is not necessary to have an electronic computer to construct such a learning machine. I visited Ulster Polytechnic in Belfast recently and John Frazer, head of Art and Design Research, told me how they had built a machine that learnt to play noughts and crosses using art students and match boxes. There is one box for each state in the state diagram. It is marked with the moves that can be made from it. These are colour-coded on each box and in the box are coloured counters the numbers of which determine the weightings for the moves. Initially each box contains an equal number of counters of each of its colours.

When a game is played, the computer's move is determined by selecting a counter at random from those in the appropriate box. A trace is kept of the moves made in the game and when the outcome is known at the end of the game the weights are adjusted by adding or removing counters. Gradually the machine improves its game. It took a class of students a week to build this machine and then they had to operate it. I am not sure how good it became but a couple of years later they are still talking about the experience.

The importance of generating the minimum state diagram is now clear: that is of recognising and removing logically identical states that differ only by reflection, rotation or some other form of rearrangement that is not significant in the game being played. If states are duplicated, the state diagram and the storage space to represent it will be bigger than need be. Also, the learning process will be diluted. Passing through one instance of a state, the program will not benefit from what it learnt from using the other instance of it. The program will behave as though it has a split memory.



'Certainly sir — you can program it to believe in absolutely anything!'

Next month

Next month I will describe some ways of generating pseudo-random values with little computation and without using the RND function.

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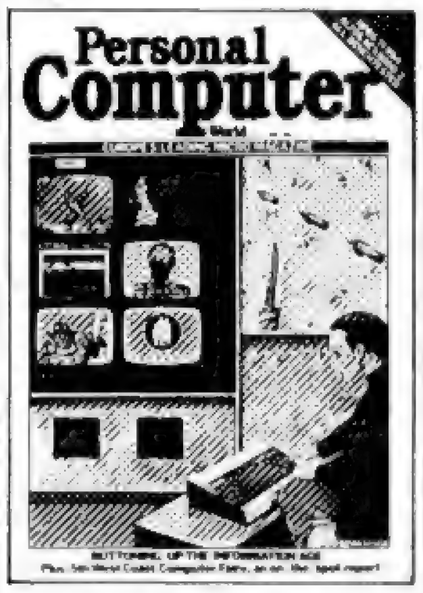
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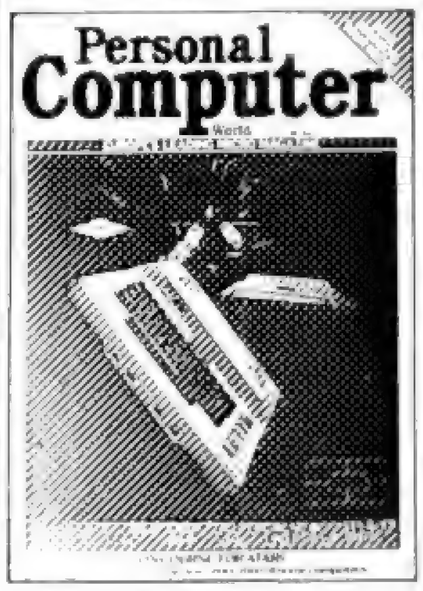


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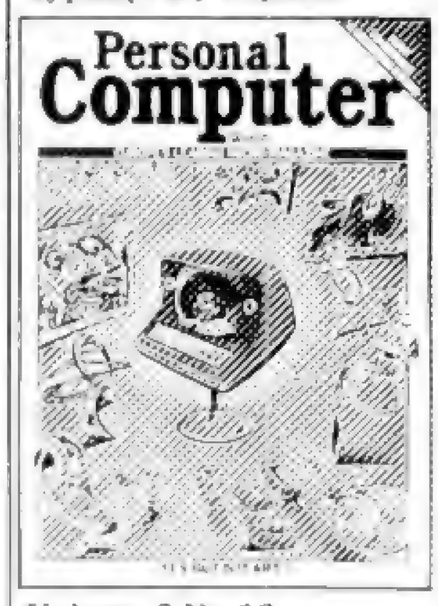


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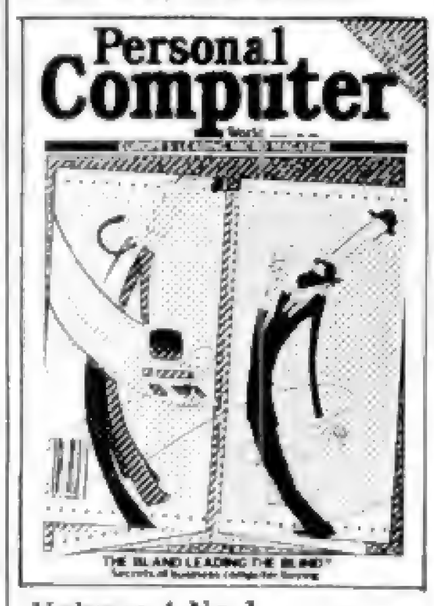


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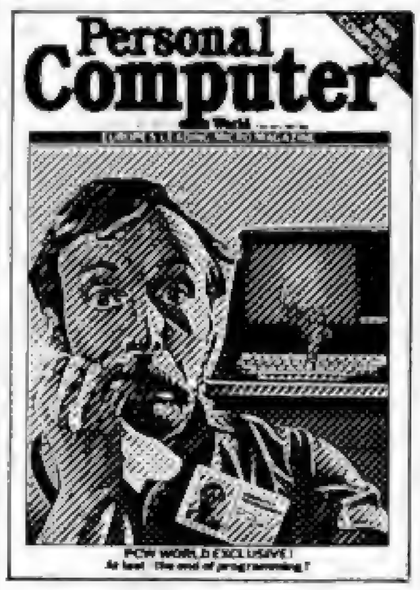
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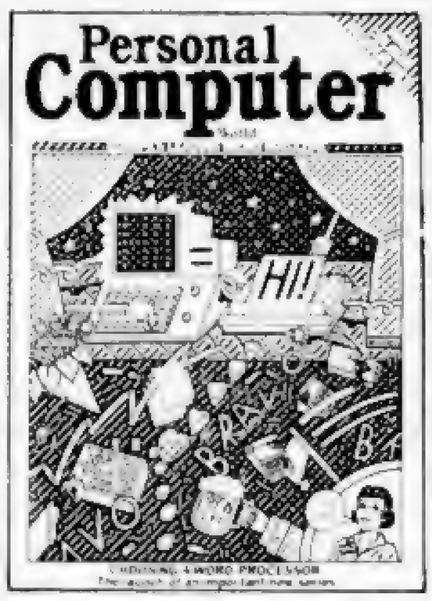


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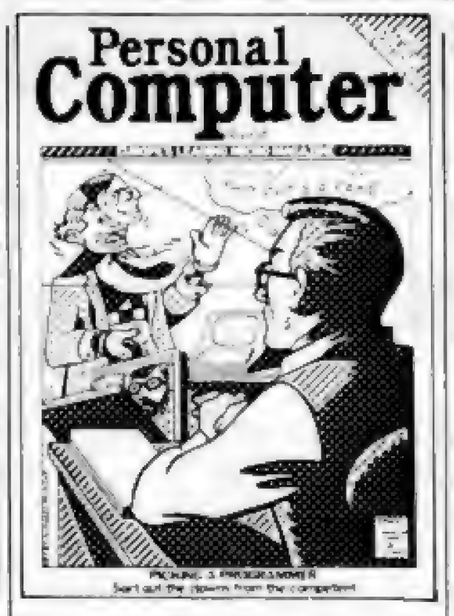
PET Greenfingers, ZX80 Bumber Bundle (3 programms), PET Brick Stop



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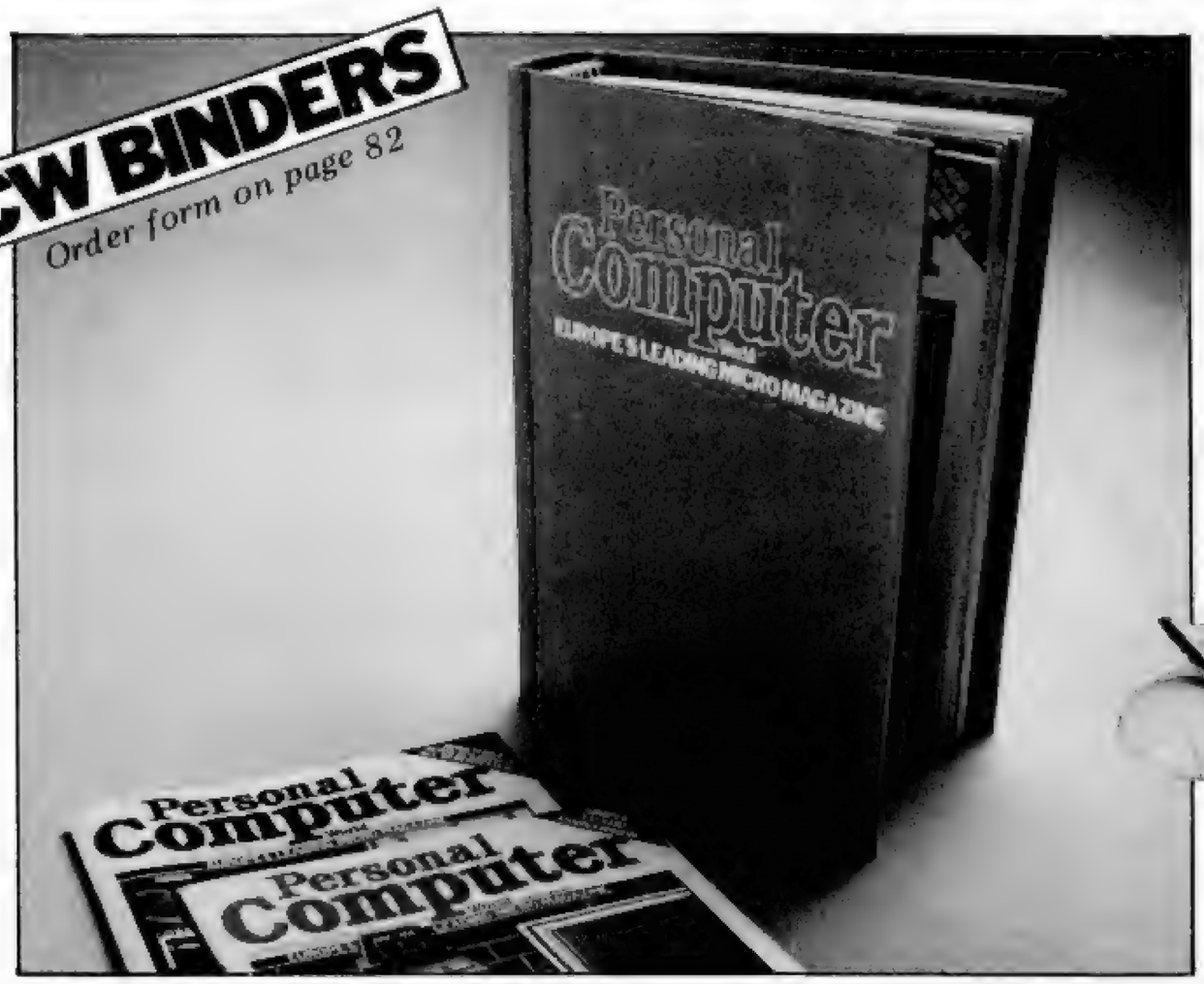
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BOOKFARE

Once again Malcolm Peltu mounts his structured programming hobby-horse — then looks at the ZX81 manual.

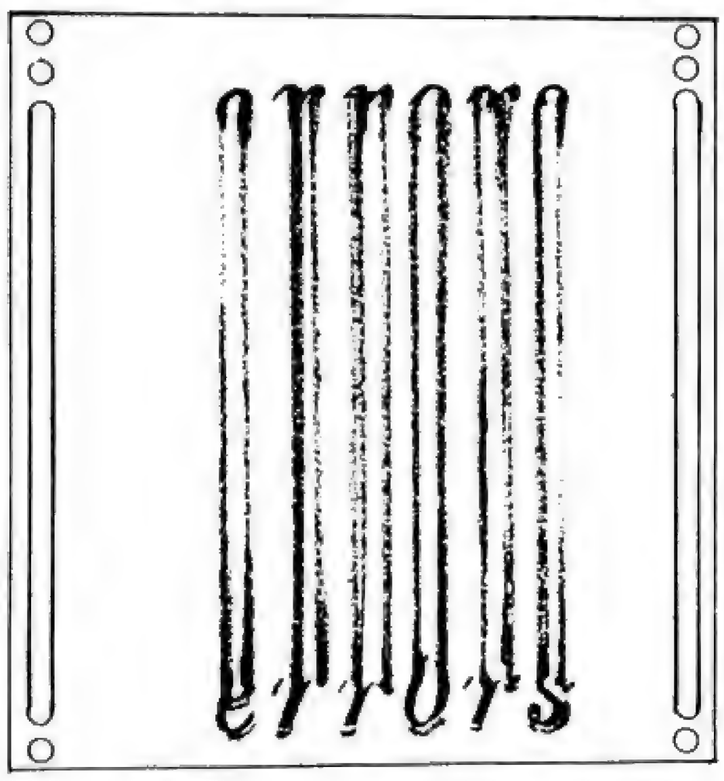
More quality, less Basic

Regular readers of 'Bookfare' might think I have been conducting an anti-Basic, pro-Cobol campaign. Through my own words and those of some books reviewed, I have indeed strongly stated the arguments against regarding Basic as a universal programming panacea.

But as reader Frank Little pointed out in the March *PCW*, the real argument is not primarily about Basic versus Cobol. What I have been trying to highlight is the importance of injecting notions of *quality* into programming objectives and implementations. My main objection to Basic is that it has done little to improve or promote concepts of programming quality, although it has helped to increase the quantity of programming being done.

I also object to the trendy notion that, just because it is easy to write a program in Basic, programming and the whole theoretical and practical foundations of systems and information sciences are also simple.

This month I would therefore like to turn the spotlight on three books which, in very different ways, examine the qualitative aspects of programming, starting with a neat little book from the National Computing Centre, *On-line programming — A Management Guide* by Joe Abbott. The other two books are concerned with structured design and

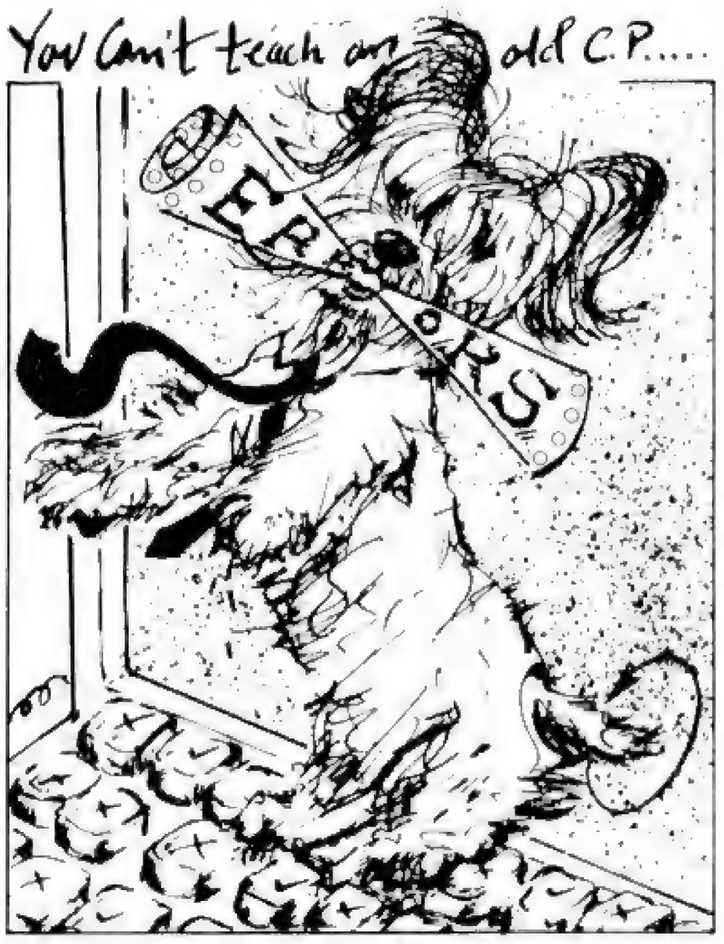


the more esoteric topic of program language definition. Later, I also have a few criticial comments on the ZX81 manual.

To most personal computer users, on-line interactive programming is a natural way of life. Yet for many commercial programmers, batch programming is still the order of the day. There was a time not long ago when on-line programming was virtually unheard of. Abbott's book is aimed primarily at managers in organisations with large DP departments but much of what he says provides a valuable insight into the programming psyche which should be of interest and enlightenment to anyone involved in computing.

I can remember some golden batch programming days when you were content with getting one run a day — and then you were likely to find the operators had shuffled your punched cards to produce a syntax error or there had been an obvious slip of the programming mind. This kind of environment created huge delays while programs were punched by the programmer or data preparation staff, delivered to the computer and the results posted back.

Plugging the programmer directly to the computer via an on-line link had obvious advantages in cutting through these delays. But, as Abbott points out, 'the introduction of on-line programming has little direct impact on the quality of programs and programming because these are governed mainly by the languages, design

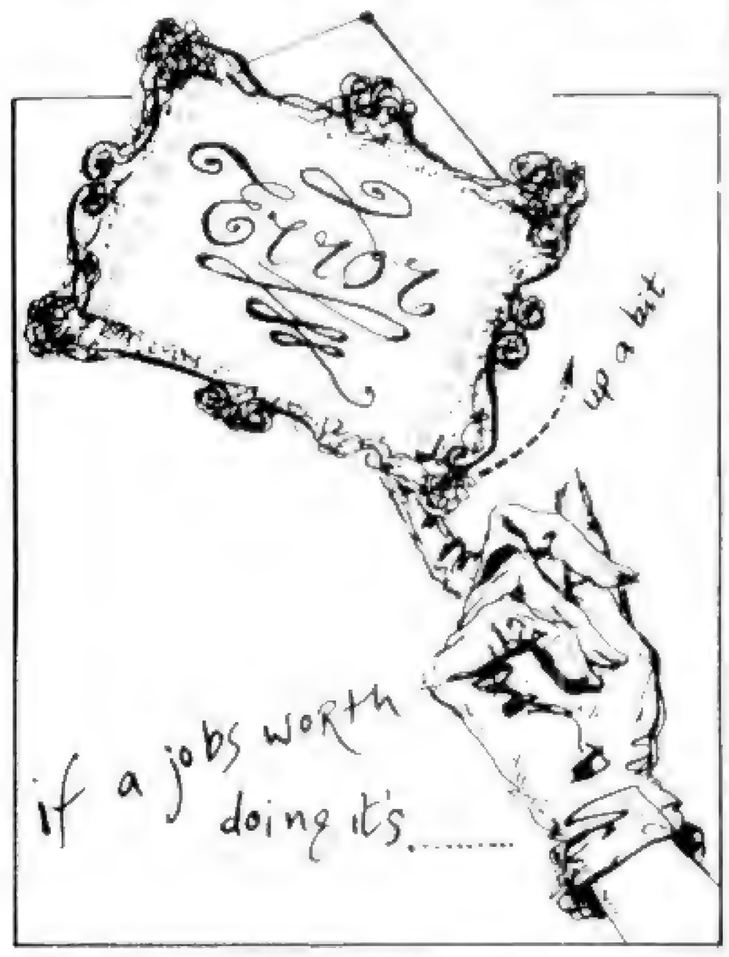


strategies and quality-control techniques used, none of which need change simply because on-line programming is introduced.'

But he says that on-line programming can have an indirect impact on programming quality, 'ranging from a substantial improvement to a substantial degradation.' The main improvements can come if the time saved in program development is at least partly used in adding to the time and resources spent on better quality control techniques, including better structured design, improved documentation, audit checks, etc. There is a danger, however, that any time saved in program development will be used as an excuse to try to rush through more programs. Never mind the quality, feel the bug-ridden width.

On-line programming, says Abbott, also creates an internal pressure on the programmer to write more lines of code. This contributes to the 'hasty and impulsive style of programming which unfortunately often characterises on-line programming.' Abbott's perception of the importance of subjective programmer attitudes in determining the effectiveness of program development is the main strength of the book. Too often, books on this subject ignore the human element.

When he was talking to Data Processing managers in researching the book, Abbott found that they were frequently at a loss to explain just why they were experiencing on-line programming problems. Abbott began to realise that



Illustrations by Connie Jude

many of these problems boiled down to an increased sloppiness in the attitude of staff and the overall operation of the department.

In an amusing and important chapter, he characterises five types of programmer: speed merchants, tedium-haters, perfectionists, technology freaks and old dogs. 'A speed merchant believes that the purpose of program testing is to find errors and that any purposeful searching for errors in advance of program testing is an unnecessary and wasteful duplication of effort,' explains Abbott. On-line programming encourages the speed merchant by enabling programs to be written in an even more quick-fire manner than before and makes him or her even more careless in the belief that errors can be eliminated simply by having more test runs.

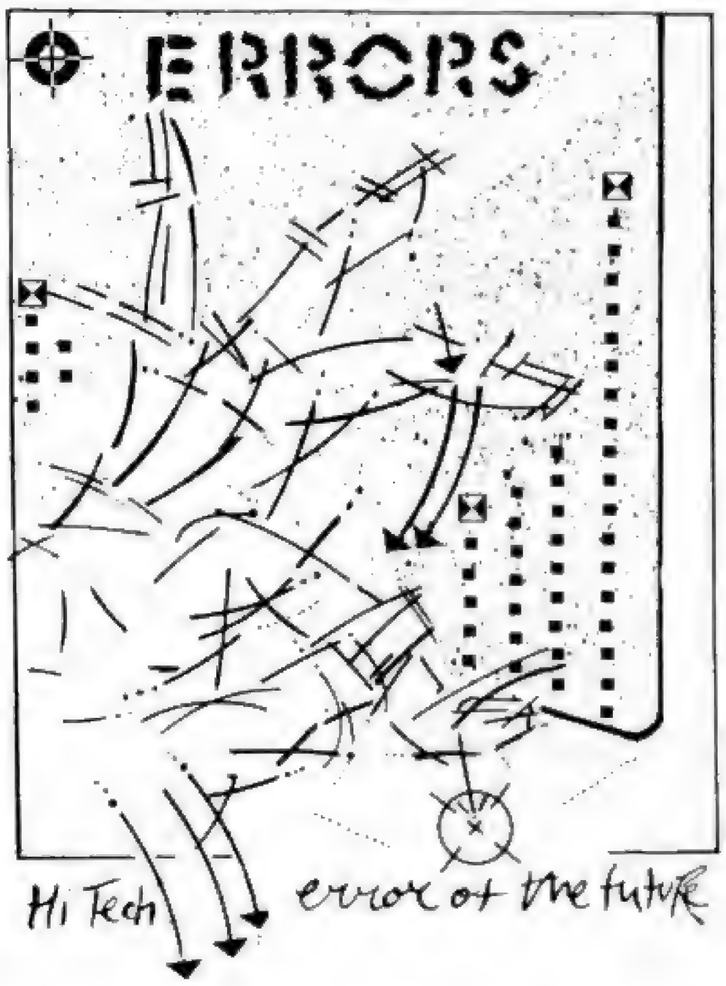
Abbott describes the tedium-haters as programmers who hate the routine side of programming. 'Program documentation, testing and any form of record keeping are seen as evils, grudgingly admitted to be necessary. Whilst such programmers hate planning, the creation of test-files and the repetitive checking of results, they love the challenge of "insoluble" program errors.' In a traditional batch environment, the tedium-hater is forced to fill in some time by doing more testing than he or she feels desirable. In on-line development, however, the tedium-hater justifies the lack of testing and documentation by arguing that on-line systems have been introduced in order to improve the speed and volume of work.

The perfectionist 'knows that the testing process has no perfect ending' and so continues to search for it. The



perfectionist is obsessed not only with accuracy but also with style in code and documentation. 'Whilst their aims may be laudable, perfectionists can be a real pain in the neck because they go to extremes and expect everyone else to do likewise.' Perfectionists regard the availability of more computing resources via on-line links as a cue to take even more time in searching for computing Nirvana.

Technology freaks make as much use as possible of hardware and software as a matter of principle. 'They become fanatical about split-screen editing, copying and duplication of code and interactive testing. When challenged about their disproportionate use of resources, they claim they have learned to use the technology where other programmers have not,' comments



Abbott. Once again, on-line programming increases the sloppiness of this programming bird by placing more resources at its twitching fingertips.

Abbott came across one programmer who declared himself an old dog who would learn no new on-line tricks. 'His loyalty and devotion to his masters earned him a reprieve and he was left alone in the hope that he would eventually grow out of it,' says Abbott.

Abbott goes on to discuss some practical guidelines for effecting on-line programming. But I have concentrated on his witty descriptions of programmer types as they are of general applicability and set the human scene for the next two books under review. These deal with complex and evolving technical debates which attempt to keep the speed freak, the old dog, the hobbyist, the technology freak and other programmers under control.

Designs on your programs

Basic and personal computers opened up the world of computing to a wide-eyed new audience by making the complexities of computing *seem* simple. Basic, however, was built with ease of use in mind rather than for implementing principles of good program design.

It has taken a long time for the computer science purists to come to terms with personal computing; for a long time they dismissed it as an irrelevant toy. But now that microcomputers are increasingly encroaching on business, industrial and scientific data processing, there is a growing need to popularise what had previously been viewed as the preserve of specialist computer scientists and data processing professionals.

Using Structured Design by Wayne P Stevens is a step in the right direction because it tries to exaplain structured design principles and practice to both the uninitiated and to DP professionals. *The Definition of Programming Languages* by Andrew D McGettrick is aimed mainly at advanced computer science students but it indicates that even an apparently abstruse subject can be express in down-to-earth terms, even if, in this case, the understandable bits are wrapped in a great deal of mathematical notation.

The subtitle of Stevens' book succinctly summarises the aim of structured design: how to make programs simple, changeable, flexible and re-usable. Stevens was one of an IBM team which formulated a structured design strategy which has had great influence in commercial DP.

'Structured design reduces the cost of developing and maintaining programs be reducing the time and effort required. It does so by reducing complexity and by making it easier to implement changes — both to fix an error and to add a new requirement,' Stevens explains in the introduction. And he proceeds to describe how this is done with a clarity that enables the principles he expounds to be easily extracted from the specific examples he uses, which are in Cobol and oriented to large DP systems.

These principles of simplicity and modularity of design, with priority given to the ease with which the program can be understood, modified and enhanced, are applicable to virtually every program. Within this structured strategy, the foibles of individual programmers become less significant because faults can be isolated within particular modules and programmers are given clear objectives on which they can the monitored.

Structured design means putting greater effort into the phase between specifying system objectives and coding. This fits in with Joe Abbott's assertion that on-line programming can improve program quality if time and resources saved by using on-line techniques are specifically allocated to giving priority to structured design and other methods which improve overall quality. As Stevens aims to provide a practical introduction to the subject, he necessarily gets involved in describing the mechanics of his particular approach to structured design. This should not put off any seeker of the essential truths of program design.

The book is full of nuggets of good advice, such as: 'Solutions can often be made dramatically simpler just by concentrating on finding the simplest alternative. It is unfortunate how much unnecessary complexity results from designs based on premature attention to performance considerations or to presumed future needs. It is easier to achieve the best performance by designing the simplest solution first.'

He warns, however, that simplicity should not be thought of as equivalent to writing the fewest lines of code. 'The fewest lines of code can probably be arrived at only through a process of optimisation. This is by definition not the simplest way to write the code and usually results in code that is hard to change.'

In *Using Structured Design*, Stevens has distilled a wealth of experience into a form which could inject some much-needed good sense into everyone's code. (Incidentally, he does not even mention Basic.)

Andrew McGettrick's book tackles a subject which is more removed from daily programming needs, the definition of programming languages. This is an important practical subject, however, because the clarity and comprehensiveness with which a language is defined influences the ease with which standards for the language can be established, compilers and interpreters developed and the quality of programs produced. It is also a subject which delves into linguistics, logic and mathematical theory, which does not lend itself to light bed-time reading. As McGettrick has written the book primarily for inclusion in computer science courses, he naturally goes into considerable depth into this theory.

But for the average, non-specialist reader, it is possible to pick one's way through the technicalities to find out some fascinating historical background to the way different languages have developed and the attempts made to rationalise language definitions.

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The Fortran language, for example, grew very much from the machine upwards. The Fortran project started in 1954 with the aim of providing a high level language for the IBM 704 computer and many of the features of Fortran are related to the structure of the machine. At a later stage, the American Standards Association (ASA) became involved in trying to standardise Fortran. Since then, the ASA, under its new name of the American National Standards Institute (ANSI), has played a leading role in international standardisation.

Another stream of computer languages grew out of a working group of the International Federation of Information Processing (IFIP) in 1960 and eventually became known as Algol 60. This working party developed an elegant means of defining Algol and took a more idealistic, theoretical approach to language design than Fortran, Cobol and Basic, which had a more pragmatic approach. The structured approach to defining Algol was reflected in the language, which promotes a block-structured approach to programming that is an important step on the way to good structured design. Pascal, among other languages, grew from this Algol seed, which is why Pascal fulfills more principles of good systems and programming theory than the pragmatic approach of Basic.

McGettrick provides sufficient evidence that he can write for a lay audience; he should try to tackle the formidable task of writing a book on this subject which avoids the technicalities and concentrates on the historical, philosophical, theoretical and practical forces which have interwoven to create the modern computing language scene.

Taken together, Abbott, Stevens and McGettrick cover a great deal of important ground which should eventually become as much a part of the personal computing consciousness as Basic and all the other paraphernalia that currently fills *PCW*.

Joe Bloggs on the ZX81 manual

While on the subject of reinterpreting complexities for a mass market, I would like to poke my oar in on the ZX81 manual. The ZX81's admirable technological capability and the value for money have already been evaluated by David Tebbutt in the May *PCW*. For a computing freak who cannot afford anything more expensive, many hours of fun can be obtained from the ZX81, particularly if you have the 16k RAM. My concern, however, is the way the ZX81 manual fails to appeal to Joe and Gladys Bloggs. Sinclair's advertising in the non-technical press makes it clear that the company is interested in selling to Joe and Gladys, the ordinary people still mystified by computing.

So what happens when the Bloggs unwrap their new ZX81? They will probably find it easy enough to plug in to the TV but they may be caused a little problem in searching for a shop that supplies a jack-to-DIN plug if they have a DIN-socket tape recorder.

But then what? They are faced with a closely-typed, 200-page manual. It starts by telling them how to get the feel of the keyboard with a very simple program. And here comes the first shock: the keyboard is cramped, crowded and complex-looking. Chapter 3 of the manual gives a half-page history which the Bloggs will probably find virtually useless. It merely states that the ZX81 uses Basic but there are other languages with 'a neater structure and greater power' or ones that can also be used 'on-line'. The words I have put in quotes should be explained to the Bloggs or else not used at all.

Then comes Chapter 4 — the ZX81 as a calculator. Great stuff if you are doing maths at school or university and feel at home with operands, unary minus and mantissa. But pity the poor Bloggs. Within this chapter, the use of commas and semicolons in the PRINT command are described. The Bloggs will want to know this but will probably miss it out here because all their worst fears about the computer being something mysterious and 'mathematical' may have been confirmed.

Chapter 5 is concerned with mathematical functions and it is only in Chapter 6 that ordinary words are used in examples, like a variable called EGGS. Yet here again, the manual quickly says 'should you want to know the square of the sine of the price of one egg type: PRINT SIN (EGGS/12)**2'. Besides confusing the Bloggs by talking about squares of sines, if they do type this on the machine, they will be greeted with an error message.

The book is structured in such a way that it is difficult to find elementary facilities, like the spacings in PRINT, without delving into chapters with titles that would be meaningless to the Bloggs. And the index is totally inadequate. I also found at least one instance of a misprint in an example (the second example on page 83) and a number of occasions where the machine did not do what was intended, as in the square sines of eggs illustration.

But the chapter on what happens when the computer gets full will probably frighten the Bloggs most. 'When the memory fills up odd things can happen; but they are not usually fatal,' says the manual. To the Bloggs, who thought they were buying a clever machine that will play Space Invaders as well as teach little Sid about programming, unpredictability such as this can be frightening, particularly when words like 'fatal' are used.

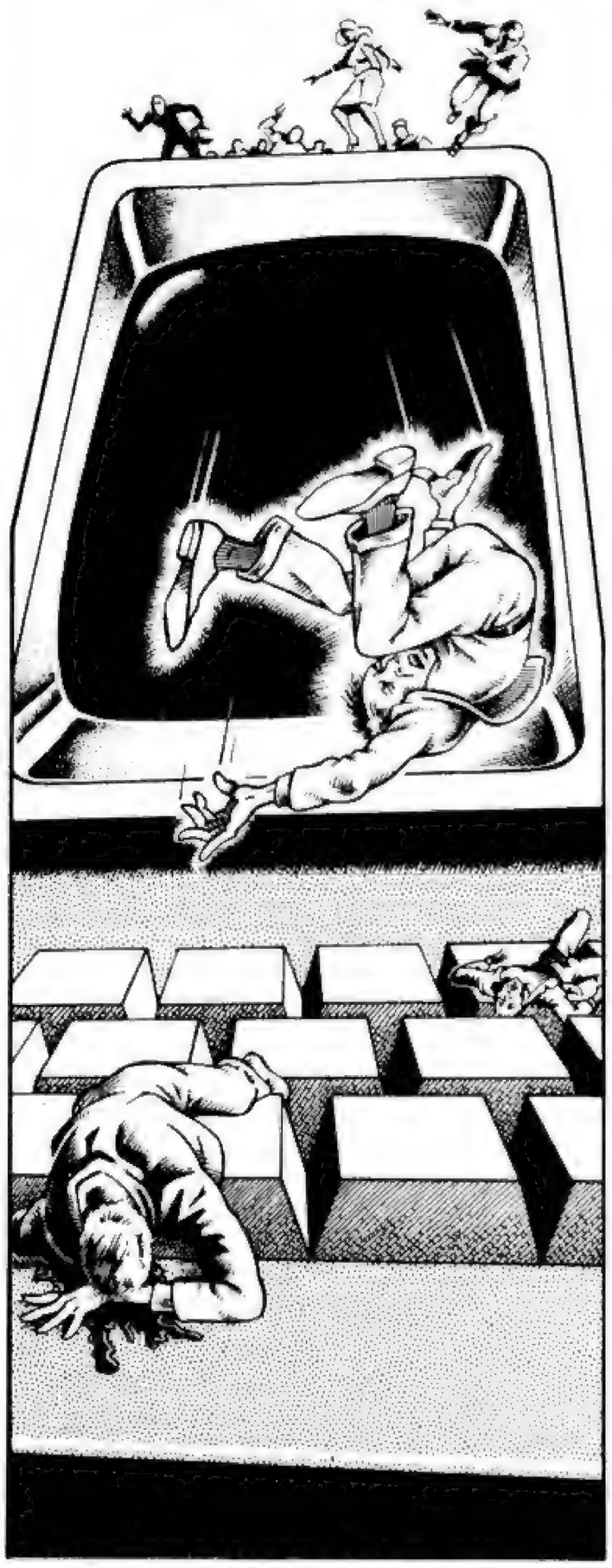
Sinclair should have done better. In fact, it did with the ZX80 manual, which was much more readable and explained examples more clearly. Perhaps it should employ Tim Hartnell to write the next one. His *Making the Most of Your ZX80* (reviewed in April *PCW*) shows that it is possible to appeal to the Bloggs by showing how to write simple games programs and, at the same time, explaining Basic principles.

It would also be nice if introductory material to systems like the ZX81 tried to explain the concepts of information management and systems design; as well as how to write a Basic program. I look forward to the Ladybird book on structured programming.

In this month's 'Bookare' were:
On-line Programming: A Management Guide by Joe Abbott (National Computing Centre, £7.50);
Using Structured Design by Wayne P Stevens (John Wiley & Sons, £14.20);
The Definition of Programming Languages by Andrew D McGettrick (Cambridge University Press, £6.25 paperback, £13.50 hardback);
The ZX81 Basic Programming Manual (free with the Sinclair ZX81).



UP THE SHARP END



Mike Knight reports on life as it really is in the micro world.

I'm sometimes surprised to find that any computer installations are successful. In fact, if some business people ran their companies the way they set about buying computers, I'm surprised their companies still exist.

In some cases, the decision to buy is made simply as a result of a chance meeting on the golf course. You know the situation: MD comes in on Monday morning, saying, 'Old Bloggs has got a computer. Find out what it is and get me a bigger one.' I wish that I could say that this was an exaggeration but I actually know four companies who installed computers and two years later had either not implemented their first system or even started the programming for their first system. In one case, the final decision to choose between two separate 'hardware' systems was made simply on the colour of one of them, even though the other system was obviously more technically suitable for that company. It's almost as if large numbers of normally sane businessmen and women are human lemmings rushing to mass computer suicide. What causes this orgy of self-destruction?

Well, I believe there are three main problem areas: computer mystique, non-communicating computer people, and good old-fashioned lack of planning.

If we loom at the first of these areas, computer mystique, the surprising thing is that it causes the most trouble to people who are usually vehement supporters of computers. The sort of person I mean is probably an avid watcher of programmes such as Tomorrow's World. His or her children are probably doing computer studies at school or college. They are also most likely to support the exhortations of politicians and others to 'join the communications revolution'. It's no surprise, therefore, that the computer starts off as some sort of deity. Now I don't think I will be able to change the sensationalism of computers in the media but the solution to mystique is knowledge. Is there a ComputerTown in your area? If there is, join it. If there isn't, how about starting one? (I know my Editor will love this but seriously, folks, why don't you start one?) If you are not the organising type, then why not buy a small personal computer or even a programmable calculator? Mystery clears when you've written a few programs, or had to reload a cassette program a number of times because of mis-reads.

Now you may have noticed that I've said nothing about talking to anyone you may know in the computer industry. The reason is simple: in many cases, such a talk would just confirm the computer mystique. In fact, for people involved in communications, computer industry employees are incomprehensible. It wouldn't be so bad if we stuck to our jargon like input and output and hardware and software, but we don't; we even change the meanings of ordinary words like 'words' and 'bits' and 'bites' (I know we spell it 'bytes' but it sounds the same). In some cases it's like talking to someone who, when he speaks, alternates each word between English and Chinese. You get half an idea of what he's saying but never really know. This, of course, is the worst danger — you may think you're communicating perfectly. I know one company where I asked if they had told their programmer what they wanted and they said yes. They had wanted a simple system for their sales ledger. But what they had got was the equivalent of a helicopter when they needed only a moped. Both were capable of going from A to B but the system supplied needed a trained pilot to operate it. Had the company concerned taken the trouble to train someone or employ someone with that knowledge, the system would have worked and, in fact, could have given them a lot of management information which may have enabled them to expand their business. They did not and so there was another computer 'failure'. But I wonder how much of the blame attaches to the programmer who was unable to tell them what he was providing?

A worse illustration of the non-communicating computer person is the following: a company I know did everything right. It started by employing a consultant who investigated the feasibility of what the company wanted to do, and finally produced a report which detailed requirements exactly on paper. This was given to the software house it employed and then programs were written to meet that specification. Two years later the system was still not implemented because, in the words of the senior partner, 'we just could not communicate with the programmer. The programs had "bugs" and he wasn't able to explain what his problems were.' Now the partner concerned has his own personal computer so was well able to understand programming problems but, even so, the computer man couldn't get through. The story has at least got a happy ending, since the company concerned has now contacted other programmers and it looks as though it will eventually get its system working.

What is so worrying about this last case is that the management involved did everything right. They started by defining what they wanted to do. They then hired a consultant to investigate whether the system could be handled by microcomputers. The consultant produced a full system specification and the company used this to get quotations from a number of local software houses. Now at this stage, had any of the software houses concerned had a 'package' which met the specification, there would now be a successful installation which would have been running for about a year. Unfortunately, the requirements were mainly in the stock control area and at that stage no packages were available which met these needs. In fact, even now they would probably still have to have a custom-built system. The problem therefore still exists. How, having defined your requirements, do you get the software house to show its ability (or lack of ability) to communicate? I would suggest that you get them to produce written program specifications and proposed operating instructions first. Now you may have to pay for this separately, particularly if you are then not going to let them do the programming, but at least you know if they can or cannot communicate. As a last resort these program specifications might enable you to do it yourself. It's more likely, however, that you could use them as the basis for writing your own program specifications in your own language. These could be used by other software houses and you would have the advantage of knowing what the programs were going to do before you got them.

Finally, I don't want to paint too gloomy a picture of computer people. Most of us try hard not to speak in a 'foreign' language, but if you don't understand us please say so straight away and we'll try and express ourselves in another way. In the end you'll get what you want — a successful computer system. But remember: when you are looking for a computer system the *last* thing you want is the computer.

Illustration by John Storey

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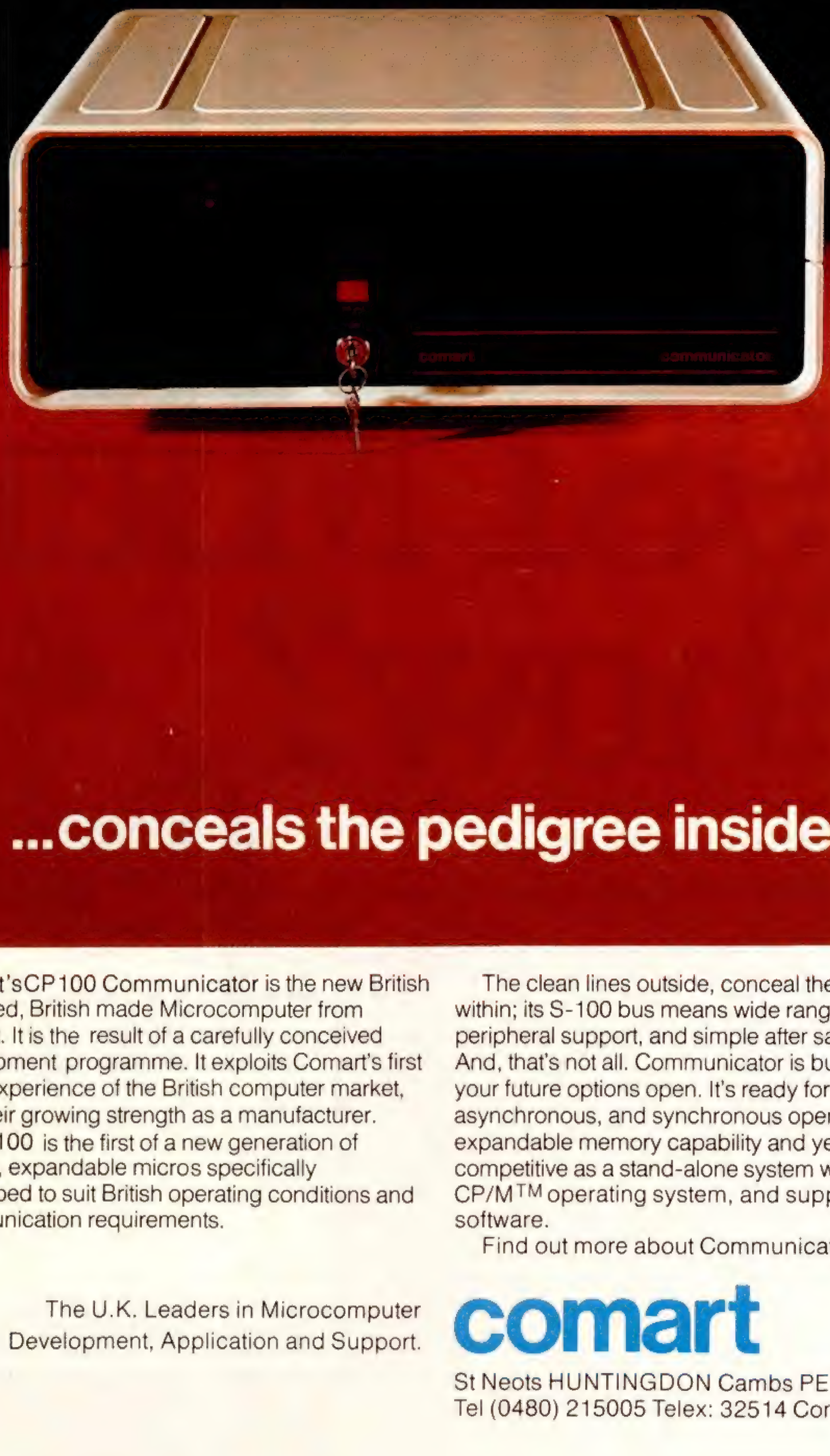
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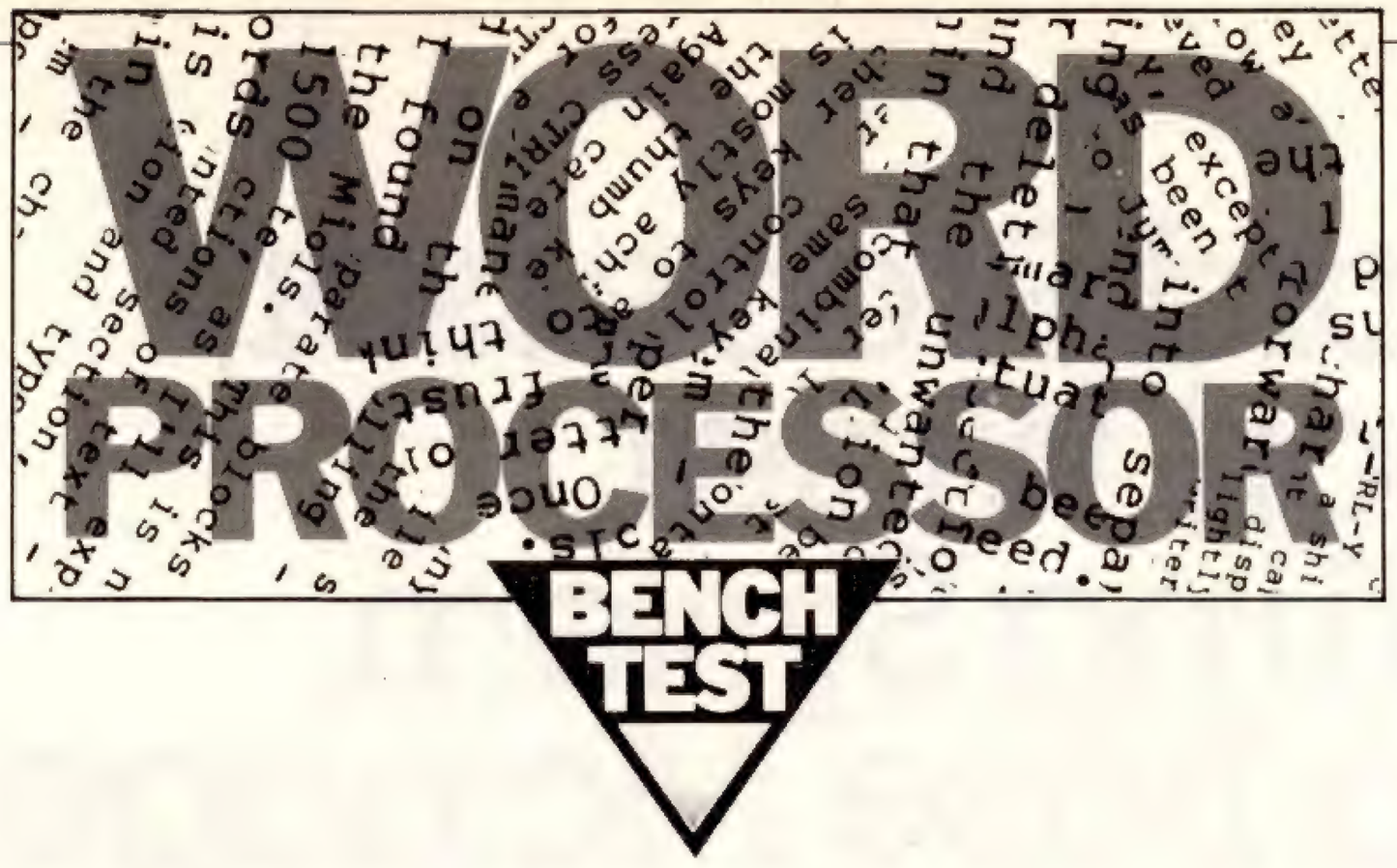
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FORMAT-80

This month Peter Rodwell looks at an Apple-based WP system

The Apple II is one of the 'old faithfuls' of the micro world; it has been around for ages (or so it seems) and is one of the world's top-selling machines. This means that programmers and retailers have had plenty of time to get used to its quirks and that plenty of companies have been able to produce hardware additions to plug into the slots provided inside the case for this purpose.

The result is that, no matter how weird your application, it's quite probable that someone, somewhere has produced a piece of hardware and/or software to do the job on an Apple.

Word processing isn't, of course, a particularly weird application but the standard Apple II is not really suited to the job, mainly because of its 40-column screen and its lack of a true, typewriter-action shift key. (And please don't write in to say that you find 40 columns perfectly adequate for WP; either you haven't tried an 80-column system and don't know what you're missing, or you're not processing lots of business-type words.) Both these drawbacks can be overcome, though; there are several 80-column plug-in cards for the Apple and a proper shift function can easily be fitted. All you need now is the WP software.

This review is of a twin-disk Apple II Europlus, fitted with a Computer Stop 80-column card. The software package is Format-80, produced in-house by Apple specialist Personal Computers Ltd (no relation to this magazine). The package is an all-in-one editor and formatter which, as a bonus, includes a mailing list handler.

Editing

Format-80 is loaded simply by slotting the disk into drive 1 and switching on the Apple — it loads and starts running automatically. The disk, incidentally, is copy protected, which means you can't make a back-up copy and have to go back to Personal Computers if the master disk fails.

After loading, you are presented with a master menu which allows you to initialise disks, view the disks' directories, load, save, replace or delete text files on disk, print text or work on the mailing list. Additionally, there are two editing commands, one for 'old' text (ie, text already in the Apple's memory) and one for 'new' text, which means what it says.

Format-80 calls each text file a 'page', which means a memory-full of text rather than a printed page. The maximum page size is 80 lines long, which means just over 900 words will fit into each file. Once you've filled a page, you must save it to disk and continue on a new page.

The editor offers two modes of operation, text entry and format. In the text entry mode, everything you type appears on the screen; the system has word-wrap built in so there's no need to hit return at the end of each line — the word you're typing is transferred to the start of the next line if it won't all fit in. As well as word-wrap, Format-80 has automatic hyphenation built in, although this seems a little timid; in theory, it should hyphenate words correctly at the end of each line and only perform a word-wrap if it can't find a suitable place to put a hyphen, but in practice, over a *lot* of text editing, it only hyphenated twice and got both of those wrong ('pocket-sized' came out as 'pocket-s-ized', for example). The hyphens, incidentally, are 'ghost' hyphens, which don't appear on printout.

You can move the cursor back to correct mistakes, using the back-arrow key, but the forwards arrow key provides a tab function since there's no tab key on the Apple's keyboard. Tab positions can be set while in the entry mode, the positions being shown by little arrows above and below the text area on the screen. Right and left margins can also be set and these are shown by white bars above and below the text. There's a column counter at the top of the screen to help set margins and there's also a line counter.

A shift lock is provided by pressing control and shift together and is unlocked by pressing shift, an action as close as it's possible to get on the Apple's keyboard to that of a real typewriter.

You enter the format mode by pressing escape, which has a toggle action; the screen tells you which mode you're in, which is important because in format mode, nearly every key activates a command. 'Format' is actually a slight misnomer — quite a few of the commands are editing commands.

The format mode gives complete cursor control: the ← and → keys function as expected, while up and down movements are also available. You can also move the cursor to the following word, line, sentence, paragraph or text block, jump to the start or end of similar locations or scan backwards or forwards through text at variable speeds to check it. The Apple has a repeat key, a must for cursor movements.

Text can be inserted at the cursor position and a simple, one-character delete function is activated by hitting the 'X' key. More elaborate deletion is also provided, operating on line, paragraph and all text and there's a blank command which differs from delete in that a blank space is left in the text, while delete closes it up.

There's a find command, which positions the cursor at the start of the sought text and there's a search and replace facility, oddly called edit, which is rather more intelligent than that on other machines: suppose, for example, you want to replace 'the' with 'some' throughout your text; unlike many other word processors, Format-80 will also act on 'The' and 'THE', replacing them with 'Some' and 'SOME', a very useful feature indeed.

A block move command is available, which allows you to place a block in a reserved part of the Apple's memory and recall it later for insertion at any desired place in the text.

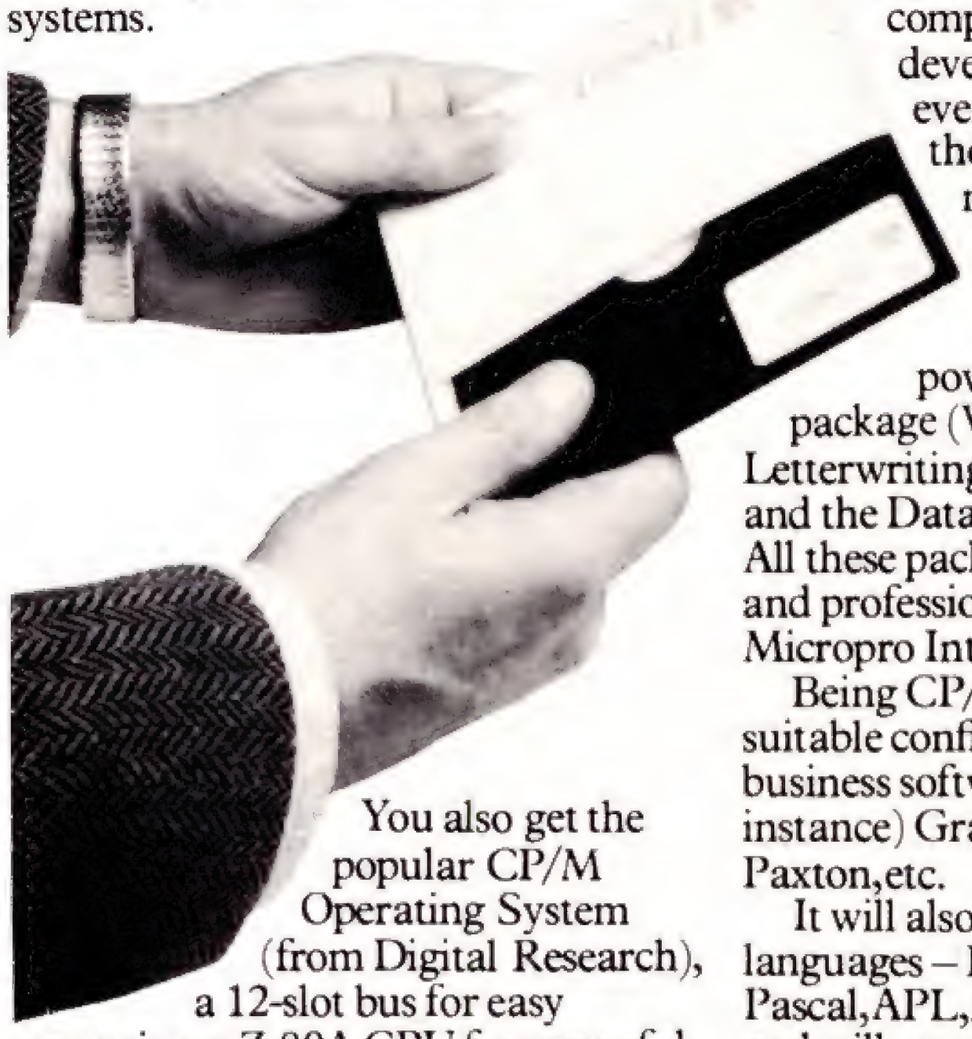
Format-80 provides a useful range of editing commands, then. The only real criticism I would want to make is of the amount of key pressing needed to activate them. To delete a line, for example, when you're busy entering text, you must press escape to get into the format mode, then D for delete

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PCW 120

followed by L for line, then escape again to continue entering text. The reason is partly that care has been taken to keep the commands easy to remember and to provide sub-menus wherever possible, and also that the Apple's keyboard has no spare keys which can be dedicated to special functions; it would be interesting to know whether the add-on numeric keypad unit, with suitably re-labelled keys, could be used to activate some of the more frequently-used commands.

Saving text to disk is quite straightforward. Each page of text must be given a name and a number so that a document can be split into several pages — 'Text 1', 'Text 2', etc. Format-80 won't let you save a page with the same name and number as a page already on disk — you have to use the replace command instead, so there's little chance of accidentally over-writing your previous efforts. Each disk can hold up to 17 900-word pages. One annoying omission is a disk-to-disk copying command, so backup copies have to be made by loading individual pages from one disk into the Apple's memory and then saving them onto the other disk.

Formatting

Format-80's formatting is a mixture of pre-set system parameters and embedded commands. The embedded ones are entered while editing, using the format mode, and have an immediate effect — you can see what you've done and undo it if it's not what you wanted. In this way you can centre lines, justify text, close up blank spaces, insert printer codes, de-justify, underline, slide lines up and down and slide words left and right. You can also align numbers by decimal point, which is handy, although Format-80 contains no mathematical functions for adding columns of figures. (One of the nice things about reviewing Format-80 was that, as it's a British product, its author Mike Hardwick was but a phone call/tube ride away. The reason for not including maths functions, he explained, was that he felt that such functions shift responsibility for the figures away from the boss to the secretary. I see his point, although I'm not sure I agree that such a shift is always a bad thing.)

Another range of formatting parameters can be set up and saved on the master disk. These include the number of lines per printed page, what happens at the end of each page (form feed or wait for a key to be pressed, for example), the pagination start number and details of the header and footer. Special ASCII character sequences can be specified to be sent to the printer in response to printer codes embedded within the text, allowing the system to cope with special printer functions such as bolding, underlining, super- and sub-scripting. Format-80 can also cope with the proportional spacing found on the more exotic printers. The parameter file also includes comprehensive heading and footing options, which is a little inconvenient as you can't then easily change these within a document.

You can print either the text in memory or one or more pages on disk and multiple copies are catered for. There is no facility for previewing the text on the screen in its final format, with pagination, headings, etc.



```
Line:  1 (80)   Position: 10                                  Enter Text

About six years ago, writer and word-games addict CY Endfield,
an exPatriate American living in London, bought one of the
early Pocket calculators.  It struck him that a calculator-s~
ized device with an alPhanumeric keyboard would make the ideal
basis for a word-game he'd invented - but he didn't like the
idea of a full keyboard with one key for each letter of the
alPhabet.  It would be too fiddly, he thought.
      Thus was born the idea for the Microwriter, a device
which would allow you to tyPe alPhanumerics using just one key
for each finger and Pressing them in various combinations to
Produce the required characters.
      There was a Problem, though.  To do this You'd have to
memorise the key combinations and that seemed an almost
imPossible task to ask of anyone.  Also, decoding the key
combinations and Producing characters from them seemed rather
complicated.
      Two innovations changed this.  Firstly, the develoPment
of microelectronics - and, in Particular, the availability of
low-cost CMOS chiPs - made the decoding task easy.  And CY
himself solved the key combinations Problem by hitting on the
```

```
Mailing list : Initialise Universal Labels Entries Main menu

[S][Q][ Label :          ][ Entry :
[ ][ ][ $name            ][ Miss J Mannleigh-Thise
[ ][ ][ $address         ][ Flat 27
[ ][ ][ "                ][ Rodwell House
[ ][ ][ "                ][ 47 High Street
[ ][ ][ $town            ][ Anytown
[ ][ ][ $Postcode        ][ SOL 1FF
[ ][ ][ $salute          ][ John
[ ][ ][                  ][
[ ][ ][                  ][
[ ][ ][                  ][
[ ][ ][                  ][
[ ][ ][                  ][
[ ][ ][                  ][
[ ][ ][                  ][
[ ][ ][                  ][

General entry : Entry Find Move Delete Blank : -                1000[
```

Top: the system as tested; centre: part of a text page during entry — the white bars show the margins; bottom: an entry in a mailing list, with labels.

Mailing list

Format-80 contains a mailing list handler which allows you to build up and manage a file of up to 442 names and addresses per disk. Each line of each entry can be given a label and lists can be sorted by any of these labels; you can also create a standard letter incorporating label names and these will be substituted in each copy of the letter by the entries corresponding to those labels. Comments can be added under each mailing list entry.

The version of Format-80 tested was a pre-release version and had one or two features yet to be finished; one of these was a logical function which will

allow, for example, selective printing of names and addresses depending on the contents of the labels' fields. Thus you could print 'personalised' letters to every solicitor in Birmingham whose name wasn't Smith, for instance.

There are facilities for reviewing, altering and deleting records in the list and for initialising disks. This last function is a little awkward as it doesn't allow you to initialise an unwanted text disk for mailing use — you have to initialise the disk using the Apple disk operating system and then re-initialise it from the mailing list section of Format-80.

Documentation

As the tested version of Format-80 was incomplete (as well as the mailing list logic, a whole-document word search and replace function hadn't been implemented), the accompanying documentation was also preliminary, taking the form of an 11-page 'First-guide'. This briefly explained most of the package's features apart from the mailing list and was intended as a very quick introduction to the system. By the time you read this review, the final version of Format-80 should be ready, complete with a 200-page manual which, in view of the high standard of the software, I would expect to be very good.

Users

How, then, could Format-80 appeal to our four user groups?

As I said last month in my review of Wordpro 4 Plus, being a member of the author/journalist group, I don't find a system which enforces the splitting of documents into a number of separate files particularly convenient to use. If you weren't bothered by this, though, the system contains all the editing and formatting functions you're likely to need. Public relations-type persons might find it particularly handy for writing and mailing medium volumes of press releases.

The report writer would also find the system limiting, but to a lesser extent than an author, although the formatting commands — of great interest to this user — are not particularly powerful. The system does, however, allow good printer control, so fancy typefaces, etc, could compensate for this.

For the manager or small businessman, Format-80 could prove a valuable tool; like Wordpro on the SuperPET, it gives you a useful WP system while allowing the computer to be used for other things — there are certainly plenty of good business software packages available for the Apple.

Secretaries would feel very at home with the system. One of the main considerations in the package's design has been to make the hardware as much like a normal typewriter as possible, in terms of the way it's operated, while taking advantage of the features which only a WP can provide. This is as it should be, for a word processor is a piece of office equipment, not a computer, and should therefore be as user-friendly as possible. Format-80 *is* friendly and would make a useful general office tool.

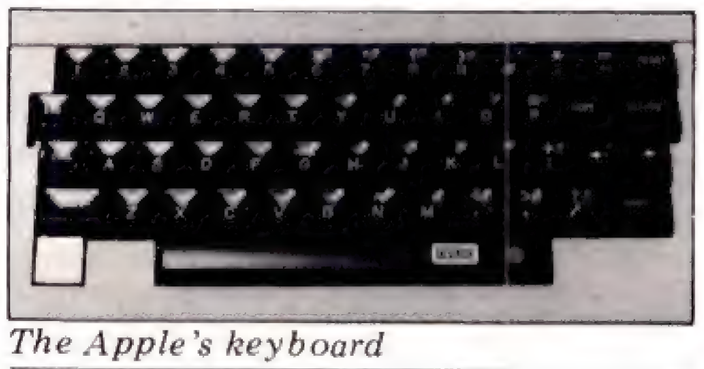
Hardware

As I said at the start of this review, the Apple has been around almost since the dawn of the microcomputer age; it's a well-proven, well-known machine with a good reputation for reliability and has a well-built, quality feel to it. If it does go wrong, then there are plenty of people around to help you out.

For word processing, I found it quite pleasant to use. The keyboard felt a little cramped as it's slightly smaller than that of a standard typewriter, but the keys have a nice solid feel to them. A major horror when using the Apple as a computer is that of accidentally hitting the reset key when you intended to hit return, thereby destroying the program in the memory; with Format-80, hitting reset merely puts you back to the master menu and leaves the text in memory unchanged.

The modification to provide a true shift key is very simple and Personal Computers will do it for free if you buy either a complete system or just Format-80 from them; if you can't take your Apple along to have the mod done, PC will supply a circuit diagram, instructions and telephone advice for you to either do it yourself or have it done by a local dealer. The mod includes a switch at the rear of the machine to restore the Apple's normal shift function, should you also want to use it as a computer.

The output from the Computer Stop 80-column board is of good quality, although there are no true descenders on letters like 'p' and 'g'; the display actually has 81 characters on 25 lines.



The Apple's keyboard

You may have noticed that I haven't mentioned a printer so far in this review. Personal Computers supplies a choice of daisywheel printers for quality output, including the new Olympia 17 cps machine; unfortunately none of these was available for the test period and a Centronics 703 dot matrix unit was supplied instead. This defied my attempts to get it to work so printing was done on my Epson MX-80, which was reviewed in the Magic Wand test in May.

Summary

Format-80 is a friendly, well-designed word processing package which provides a useful range of functions for general office/small business use. It would appeal most to small business users, especially those wanting to use their Apples for other purposes. It's a particularly helpful system, with menus and sub-menus for almost every command, although the penalty paid for these is that you have to make more keystrokes to activate some functions than are necessary on other systems.

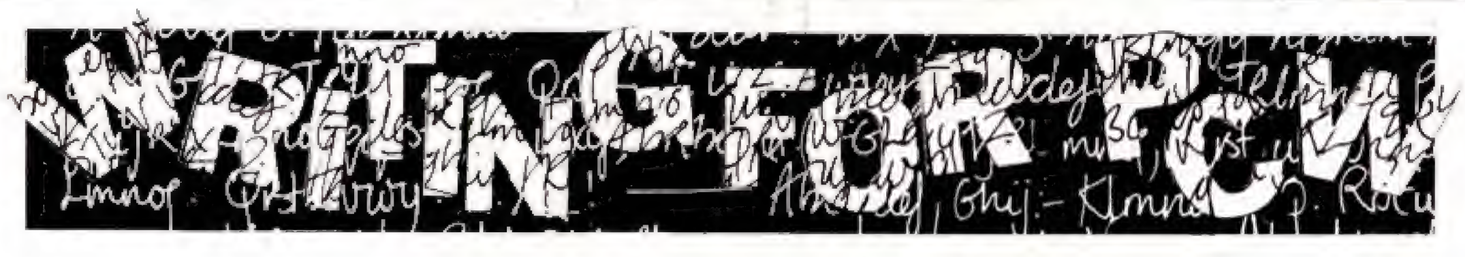
The Apple in the configuration tested is a pleasant machine for word processing, has a good reliability record, plenty of service backup across the country and can be used for many other applications.

Finally, because of the system's 900-word maximum page capacity and the lack of the document-wide search and replace function on the version tested, it wasn't possible to run any of our WP Benchmarks.

Prices

48k Apple II with twin disks and monitor	£1664
Computer Stop 80-col board	175
Format-80	300

Prices exclude VAT and are those of Personal Computers Ltd, whom we would like to thank for the loan of the hardware and software tested.



PCW welcomes approaches from would-be writers, even those who may never have appeared in print before. In this game it is often those with practical experience who have important things to say so we don't mind too much if their prose is less than perfect. Providing that submissions have a sensible structure and follow a logical sequence, we can take care of the polishing. Here are some tips:

If the article is already written, simply send it in, making sure that your name, address and 'phone number appear on both the article and the covering letter. If you have submitted the same work to other magazines you should tell us — it would be embarrassing (to say the least) if the same article appeared in more than one.

If you have an idea for an article or a series, write us a letter outlining your ideas. A one or two page synopsis giving the proposed structure, sequence and content will give us a sound basis for discussion. Please give us a daytime 'phone number if possible.

If you have nothing specific in mind but feel qualified to conduct case studies, Benchtests or whatever then drop us a line saying what you'd like to do and why you think you're qualified to do it. We're not particularly looking for strings of academic qualifications — experience carries just as much weight.

Dick Pountain is always on the look-out for interesting calculator features and we wouldn't mind seeing one or two readers getting on their soapboxes but remember: even articles such as this need a structure.

Reading *PCW* will give you a good idea of the style we prefer. You may notice that we try to avoid pomposity at one extreme and flippancy at the other (except in 'Chip Chat', that is).

Finally, have a look through back issue indexes and try not to re-invent any wheels. Oh, we almost forgot — *PCW* does pay for all published work.

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* The Vector 3 intelligent terminal.

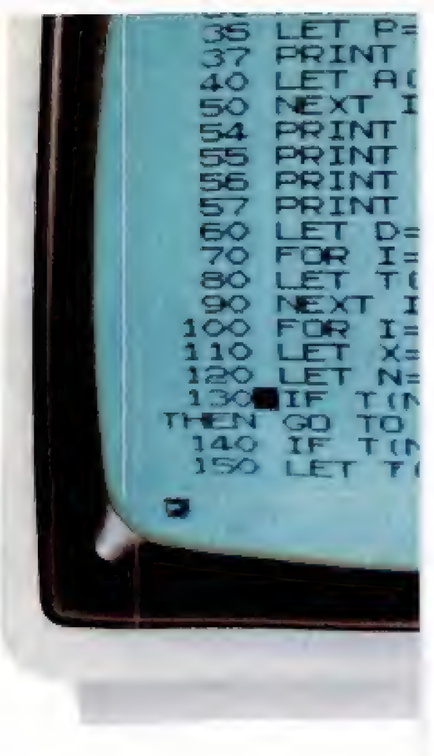
Also the standard software package supplied with all Vector systems: CP/M 2.-2, Microsoft Basic 80, Scope (Editor) and Raid (Debugger).

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PCW 123

New! Sinclair ZX81 Personal Computer.



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Reach advanced computer comprehension in a few absorbing hours

1980 saw a genuine breakthrough – the Sinclair ZX80, world's first complete personal computer for under £100. At £99.95, the ZX80 offered a specification unchallenged at the price.

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Now the Sinclair lead is increased: for just £69.95, the new Sinclair ZX81 offers even more advanced computer facilities at an even lower price. And the ZX81 kit means an even bigger saving. At £49.95 it costs almost 40% less than the ZX80 kit!

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With the ZX81, it's just as simple to teach yourself computing, but the ZX81 packs even greater working capability than the ZX80.

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And the ZX81 incorporates other operation refinements – the facility to load and save named programs on cassette, for example, or to select a program off a cassette through the keyboard.

Higher specification, lower price – how's it done?

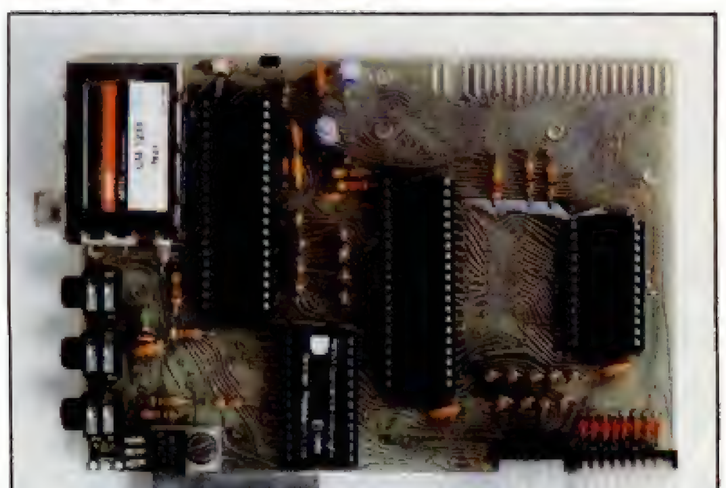
Quite simply, by design. The ZX80 reduced the chips in a working computer from 40 or so, to 21. The ZX81 reduces the 21 to 4!

The secret lies in a totally new master chip. Designed by Sinclair and custom-built in Britain, this unique chip replaces 18 chips from the ZX80!

Kit or built – it's up to you!

The picture shows dramatically how easy the ZX81 kit is to build: just four chips to assemble (plus, of course the other discrete components) – a few hours' work with a fine-tipped soldering iron. And you may already have a suitable mains adaptor – 600 mA at 9 V DC nominal unregulated (supplied with built version).

Kit and built versions come complete with all leads to connect to your TV (colour or black and white) and cassette recorder.

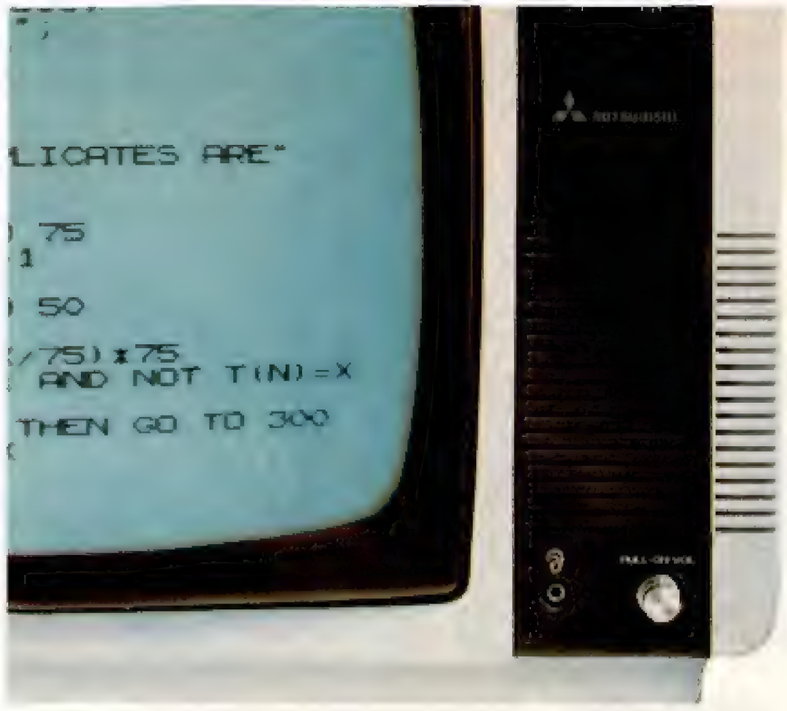


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Designed exclusively for use with the ZX81 (and ZX80 with 8K BASIC ROM), the printer offers full alpha-numerics across 32 columns, *and* highly sophisticated graphics. Special features include COPY, which prints out exactly what is on the whole TV screen without the need for further instructions. The ZX Printer will be available in Summer 1981, at around £50 – watch this space!



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	Mains Adaptor(s) (600 mA at 9 V DC nominal unregulated).	10	8.95	
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	8K BASIC ROM to fit ZX80.	17	19.95	
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PASCAL READERS WRITE

Chris Sadler presents further feedback following his proposed series of Benchmarks.

I read your Pascal Benchmarks article (PCW March) with interest as I am considering buying a Pascal compiler/interpreter. As I have an S100 machine running CP/M I thought I might obtain a few useful comments from your correspondent Mr C J Neville and I have therefore enclosed a letter which I would be extremely grateful if you would pass on to him. I would welcome your comments.
Russel Gadd, Southsea, Hants

As far as I know, there are five possible compilers available under CP/M. Although I haven't had much experience with any of them and have never even laid my hands on two, I do have a bit of information (mostly hearsay, gossip or manufacturer's claims). Any reader who can add to (or correct) these impressions with actual experience as a user of one or more of these is invited to write in.

TCL Pascal is produced by TCL Software and is a wholly British product. It compiles into p-code and is said to meet the Pascal standard. It runs in two modes (see elsewhere in this article) with the compiler either memory- or disk-resident; the former of these is easier and faster to use but restricts the possible size of the user program for a given amount of memory. It is also relatively cheap compared to the other CP/M (Pascal) compilers.

Pascal-M (from Sorcim) also compiles into p-code and is supposed to be very close to UCSD Pascal — so much so that programs can transfer almost directly, but I cannot tell what the 'almost' entails as I've never actually used this system. Apparently a version of this runs under CP/M 86 (CP/M on the 8086) so that upgrading to a 16-bit system ceases to be a problem.

Pascal-Z (from Ithaca Intersystems) compiles to macro assembler. This enables Pascal source programs to be run with machine code or other language routines patched in. Judging by our timings, however, the arithmetic is really slow and I believe that Pascal-Z is probably further from the standard than the others are.

Pascal—MT+ (from MT Microsystems) compiles to native code and has the advantages of being capable of directly producing ROM-able code (although some of the others may do this) and of being able to utilise the AMD 9511 maths chip (I don't think the others can do this) which should keep the number-crunching programmer happy.

MS-Pascal is the new Pascal from Microsoft. It also produces native code and Microsoft is apparently 'committed' to keeping to the standard. I've never used this one but I'm told that it operates on three levels: level one is written to the ISO standard; level two has the sorts of extensions found on the UCSD system (eg, random access files, string-handling) and a bit more; the level three is 'system' Pascal.

Prices are: TCL Pascal £120, Pascal-M £195, Pascal-Z £205, Pascal—MT+ £250, MS-Pascal £195.

I enclose a table of Benchmark timings for UCSD Pascal on the North Star Horizon (which is, of course, a Z80A, 4 MHz rig). All timings were obtained using a digital stopwatch running each Benchmark three times and averaging the result. To assist timing, the modification proposed by Dr John Rostron was adopted.

When we attempted to run Benchmark 'maths' we obtained, as did Dr Rostron, a floating point error. This is due to attempting to calculate EXP(90) and not EXP(1000) as the good Doctor suggests. This brings me to an interesting point: how have those other UCSD times for program maths been obtained? If the contributors had to modify the program, would they let us know the source code so that we may run a fair and impartial test?
Keith E Gould (on behalf of Plymouth District Amateur Computing Club)

Thank you for your timings. I hope that, by now, you will have spotted the modification (published in March *PCW*) which makes maths run correctly.

With reference to the relatively slow timings for TCL Pascal running on the Commodore PET, can we make the following points?
1. This compiler had to be extremely compact to run on a standard 32k PET. Hence some loss of speed.
2. It can only be compared fairly against the other 6502-based machine, Apple running UCSD Pascal in a minimum of 48k. It cannot obviously be compared for speed when the machines are 16-bit or even against Z80-based machines with full 16-bit stack pointer.
3. Please accept our timings for the CP/M version running on the Tuscan microcomputer.

It may be of interest to your readership that TCL Pascal for PET and TCL Pascal for CP/M has now sold over 2000 copies worldwide since the launch of the product in July 1980. We have also concluded two major OEM contracts for parts of the source code. Not bad in six months?

The book of TCL Pascal is being launched in June 1981.

Also, as a final thought, many PET owners will be pleased to know that TCL Pascal for the 80-column PET is nearly ready and should be available from TCL Software or PET dealers in late March 1981. This means there will be three versions: the 3032, 4032 and 8032 in the new V1.6 release.
Graham Clifton, Director, TCL Software.

Of course you are right, account should be taken of the relative 'size' (word-size, memory, clock speed and architectural features) of the machine on which the Benchmarks are run and I withdraw my previously-stated disappointment. As a user, it is important to know not only where your system stands in relation to others but why.

The enclosed times were recorded for TCL Pascal under CP/M. As both a resident mode and a compiling mode are offered, both were timed. For the compiling mode the fastest option, which suppresses error checking, was used, but as the TCL Pascal only compiles to p-code rather than native Z80 or 8080 code, the timings are rather slow.

For the resident mode there is an overhead of 14.2 seconds to load the compiler (8in single-density disks) but this is only required once per Pascal session.

I found, incidentally, that TCL Pascal will not *run under CP/M 2.2, only under CP/M 1.4. Peculiar things happen like*

getting extra characters on input under 2.2 that work correctly under 1.4. Other programs do not behave in this way. Do any of your other readers find this?

Although I like Pascal as a language, the development system I tend to use is the Microsoft Basic Interpreter/Compiler combination. Interpreting is a most satisfactory way of debugging a program — extra lines can be quickly added and particular variable values printed at the console, whereas the compiled version will run at high speed. Compiled Basic on my system runs more quickly than interpreted Basic on a Tektronix 4052 'High Speed' desktop computer.

On my S100 system I use an Ithaca Z80 CPU card running at 4 MHz with one wait state, 64k of Expandoram dynamic memory, and a variety of other goodies including a fast video digitiser with the 6-bit TRW chip, the Micro-Angelo graphics display with its own 5 MHz Z80B and 32k RAM, four A-to-D channels, three D-to-A channels and a GI sound generator and Nat Semi's time-of-day clock.

From your timings it looks as though either the S100 Microengine board or a Z8000 board will have to be a future addition to my system but could I also appeal to some software house to do for Pascal what Microsoft has done for Basic, and bring easy development to a fine language.

David J Taylor, Edinburgh

You certainly seem to have a very fancy system and I can see why you'd like a very flexible development 'environment' to help you to marshall all your features and facilities. I would have thought, however, that the opportunities offered by Pascal for minimising logical and declarative bugs would outweigh the ease with which these problems (more prevalent in Basic) can be ironed out with an interpreter. I wonder if you have ever considered the UCSD p-system which is billed as a 'program development environment'? — when its compiler finds an error it offers the option of carrying on with the compilation or dropping you straight into the editor at the offending line.

Now you have corrected your Pascal Benchmarks, I have run them on our Cyber 174 mainframe, with Pascal3, the latest version of Wirth's original CDC compiler. At first sight these don't show the advantage of a very fast floating point processor. But despite their names, realarithmetic and realalgebra are tests of integer arithmetic and integer-to-real conversion! This isn't good enough! The tests show the stupidity of current Pascal compilers even on mainframes, for any Fortran optimising compiler would notice the inner repeated statements could be taken outside the do-loop.

My motivation for running these Benchmarks was to assess the relative power of 16-bit micros, such as the Onyx. There is a considerable debate as to how much serious scientific computing can be done on micros. During the day in term our mainframe supports about 140 users on two CPUs and many peripheral processors. Even under those conditions, the user has more power available to him than any of the machines in your table except perhaps the Microengine. It would appear to be some time before the scientist's dream of a personal computer to do all his computations will be realised.

We are about to enter the word processor age but the need for many mathematical symbols ruled out a micro-based solution there, too.

Dr B D Ripley, Dept of Mathematics, Imperial College, London

I'm not too sure what point you are making with regard to realarithmetic and realalgebra. The process you describe would certainly occur if the crucial assignment statements were indeed Fortran statements, but, as I understand it, a Pascal compiler would make the integer-to-real conversions first (at compile-time in the case of realarithmetic, at run-time for realalgebra) and then evaluate the expression in 'real' terms for assignment to the real variable. Maybe that's more 'stupid' than an optimising Fortran compiler would be but the first optimising Pascal compiler to be produced is certainly going to show up in the Benchmarks.

I've given quite a bit of thought to your remarks about mainframes versus micros. I think you are right that a mainframe environment can provide special hardware (like your floating point processor), specialised software and expert personnel — just the kind of computing power a research scientist might want and at a price only the research scientists can afford. However, there are other kinds of computing power (like flexibility, availability, portability, even personal ownership) which appeal to other people (including research scientists with possible less computationally onerous tasks) and at costs which are more attainable.

Incidentally, there are at least three micro-based solutions to your word processing problems — Wordcraft (with the scientific option) on the PET, Wordstar on any system with a programmable character generator (eg, Cifer 2684) and the AVTEK 1800. These are the ones I know of — perhaps there are others.

It is interesting to receive timings for a mainframe — I have heard rumours that there are several systems (mainframes and minis) with our Benchmarks lying around on them but whose figures have not seen the light of day — come on, there's plenty of room in the table. My thanks also to P S Bott of Harrogate for his table of timings for the North Star Horizon using the UCSD p-system. Don't forget about the UCSD Users Society (USUS(UK)) conference at Westfield College (11-12 September). Details from Malcolm Harper, Secretary, USUS(UK), 45 Banbury Road, Oxford OX2 6PE.

This is timed to coincide with the *PCW* Show and delegates will be able to book accommodation (and get half-price show tickets) from the night of 9 September, to attend the Show on the 10.

Stop press: I have received (too late for inclusion) a letter about NASPAS — Pascal on the Nascom — and have discovered Pascal on the Acorn Atom. I shall investigate both of these for a future article.

If you have a contribution for Pascal Benchmarks, sent it to Chris Sadler, c/o *PCW*, 14 Rathbone Place, London W1P 1DE.

PASCAL BENCHMARKS SUMMARY

Benchmark	PDP 11/04/OMSI (with floating point)		Onyx/UCSD	Microengine/UCSD	Heath H11A/UCSD	TRS-80/Bourne	Horizon/Midas/Pascal Z	Horizon/UCSD	Tuscan/TCL	Ithaca/TCL (compiling)	Ithaca/TCL (resident)	Apple/UCSD	PET/TCL	Cyber 174
magnifier	0.3		0.5	0.8	3.9	2.2	2.4	3.5	4.5	5.0	5.8	6.4	9.5	0.1
forloop	3.3		6.1	9.5	42.8	26.6	29.3	38.5	56.2	62.6	69.7	74.3	119.0	0.6
whileloop	2.5		5.9	9.3	40.1	28.6	29.9	35.0	66.5	74.4	99.0	70.0	158.0	0.8
repeatloop	2.2		5.4	9.1	35.0	26.4	29.3	31.2	62.1	69.1	107.7	63.3	168.0	0.8
literalassign	3.9		6.7	11.0	49.9	29.5	30.3	44.8	67.6	75.3	83.8	88.5	149.0	0.8
memoryaccess	4.3	4.2	6.9	11.4	52.0	31.2	31.4	46.0	70.1	77.7	86.8	91.0	155.0	0.9
realarithmetic	58.0	42.8	—	8.7	61.7	—	192,9	47.2	69.4	80.0	83.1	93.0	164.0	0.3
realalgebra	53.3	38.2	—	6.8	40.6	—	127.9	44.7	51.7	59.4	62.3	83.4	156.0	0.3
vector	9.4		22.7	26.4	102.9	72.2	51.6	96.4	154.1	172.5	201.2	203.3	532.0	1.2
equalif	5.3		9.9	16.0	66.8	46.1	33.9	58.8	104.1	115.7	149.1	116.7	240.0	1.6
unequalif	5.2		9.9	15.8	65.8	45.9	33.4	58.4	101.1	112.5	140.5	115.3	231.0	1.4
noparameters	3.0		7.4	4.5	26.4	21.4	13.7	20.7	28.3	31.3	48.2	50.2	66.0	1.9
value	3.9		8.0	5.0	29.3	21.7	14.2	23.9	31.7	35.1	52.4	54.4	75.0	2.0
reference	3.9		7.9	5.0	29.7	—	15.0	24.2	32.4	36.1	53.3	55.3	77.0	1.9
maths	21.6		—	7.0	25.3	—	314.2	23.6	—	206.9	219.7	66.0	—	0.2

Timings are in seconds, rounded to nearest 0.1 sec.

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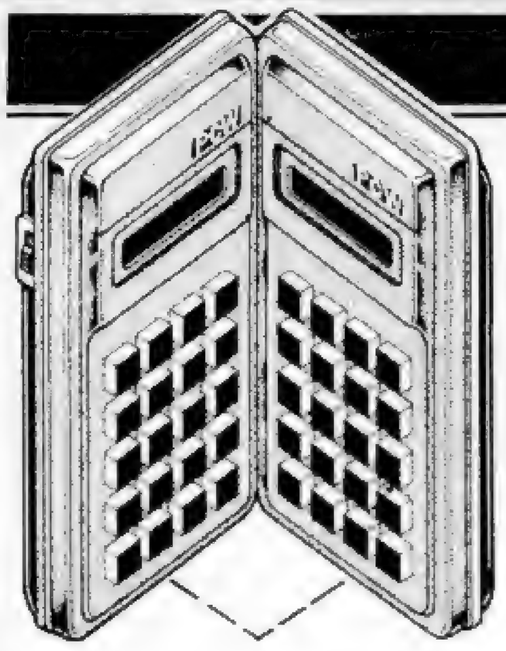
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Compiled by Dick Pountain

EVEN QUICKER COMPUTATION ON THE CASIO

Just after I sent my last column to press, I received a long treatise from Michael Leigh of Salford which contained much of interest concerning the Casio fx 502p. In particular, it contained the full algorithm for subtraction of alphanumerics plus a very full rationale for the concatenation of alpha characters. This material, however, is rather technical, involving truncated adders and shift routines, and moreover it duplicates much of what I said last month, albeit more rigorously.

I've extracted a part of Michael's article which deals with the Casio's jump and subroutine destination searches, suggesting program structure for optimal execution speed. This is printed below.

Before launching into these, I shall present Michael Leigh's algorithm for alpha subtraction in the same notation used in last month's addition algorithm for the sake of consistency.

Take as our example 92E—C1.

a) Express as strings of place values: ie, [09][02][13] and [12][01].

Subtraction always proceeds by taking a shorter string from a longer string, and if of equal length, then the one with the lesser value from the greater value in the leftmost (most significant) place:

ie,
```
[09][02][13]
   [12][01] −
-------------
[09][−10][12]
```

Had our example been C1 − 92E, we should still proceed as above, but the answer would be negative.

b) Wherever a place result is less than 0 *or* greater than 9, carry a 10 from the next place on the left and subtract one from this place. Do this starting at the rightmost place:

```
[09][−10][12]
then [09][−11][22]
then [08][−1] [22]
```

Note that the criterion for a carry applies to the value *after* any carry from the right has been subtracted

so that
```
[10][11]
[09][21]
```

stops there as the second place is not now greater than 9.

c) Any place which now exceeds 15 or is still less than 0, is adjusted by adding *or* subtracting 16 to put it in $0 \leqslant x \leqslant 15$.

ie,
```
[08][−1][22]
    +16 −16
------------
[08][15][06]
```

d) Translate back. Values 0-9 are numeric, 10-15 are alpha.

So [08][15][06] ≡ 8 ( ) 6

which is the displayed answer, ie, 92E −C1 = 8 6.

The only complication comes when the result in the leftmost place falls negative or greater than 9, ie, requires a tens carry. In this case a 10 may be carried in from one place further to the left by writing a [00] as follows:

EP—20 ≡
```
[13][11]
[02][00] −
----------
[00][11][11]
[00][10][21]
[−1][20][21]
[09][20][21]
  −16 −16
----------
[09][04][05] ≡ 945.
```

Whereas EP—30 ≡
```
[13][11]
[03][00] −
----------
[10][11]
[09][21]
  −16
----------
[09][05] ≡ 95.
```

This extra tens carry is limited to one place as shown and results in a leading 9 in the answer, which has one more digit than the subtrahend.

Incidentally this process makes sense of the way the 'magic number' — ββββββββββ converts strings. It does not, as I wrote last month, violate the addition rules, but complies with the above subtraction rules, since the magic number is negative! I accept a slap on the wrist.

Casio program structures

It has been noted in previous articles that the alpha characters □, P, C, E, —, ( ), may be used as indirect addresses for the INV IND, GSBO command, control passing to the first 0, 1, 2, 3, or EXP respectively encountered in the program stack, execution commencing from the next step. While this technique is only likely to be of use in the one-off situation, it points to the clear need to understand the way in which the program stack is structured. This article is therefore devoted to programming techniques which may be used to speed up processing time. They are particularly relevant, therefore, where response time is important, eg, games, iterative statistical computations, function evaluation, equation solving routines.

Subroutines

Subroutines may be used to reduce the length of and hence simplify a program listing. Use of subroutines, however, can have a marked effect on execution time and if carefully placed can reduce execution time — unfortunately the converse also holds true. When a GOSUB command is encountered, a search is initiated from the *beginning* of the stack. This gives us the cardinal rule:

1) The most frequently used subroutines should be placed at the bottom of the program stack. To this we may add;

2) Shorter subroutines should be placed as low in the program stack as possible.

The combination of these rules results in a trade-off where if P0 has length L_0 and is to execute N_0 times and P1 has parameters L_1 and N_1, then if $L_0N_1 > L_1N_0$ then L_1 should take precedence over L_0.

The program stack is built up according to the following rules:

1) The program sequence in the stack follows the order in which the programs are keyed in, irrespective of the program number;

2) When steps are added/deleted, the program sequence remains unaltered — only the relative spacing of the programs changes.

Thus, the stack sequence is determined by the order in which the P keys are pressed.

Jump commands loop control

A key factor in the usefulness of a computer is its ability to test for a given condition and then, on the basis of the result, carry out alternative procedures. The GOTO/LBL type commands therefore form the backbone of a program by defining its logical flow structure.

The GOTO/LBL commands serve two purposes:

1) To enable alternative procedures pending the result of a test condition (conditional jump);

2) To enable a sequence of steps to be repeated (loop control).

Recognising the fact that loop control jumps are executed more frequently than conditional jumps, the Casio is designed so that GOTO initiates a backward search through the program. Should this fail, a forward search then begins from the GOTO command. The search is restricted to the program in which the GOTO statement occurs; if P0 has GOTO 1 at step 20 and LBL 1 at step 40, then the search will be:

1) Steps 19 to 0 then; 2) Steps 21 to 40.

A useful corollary to the above 'search rule' follows. Contrary to the Casio manual, which suggests that labels must be uniquely defined within a program, a label may be used more than once, the only proviso being that the 'search rule' results in the logic flow desired by the programmer. See Figure 1.

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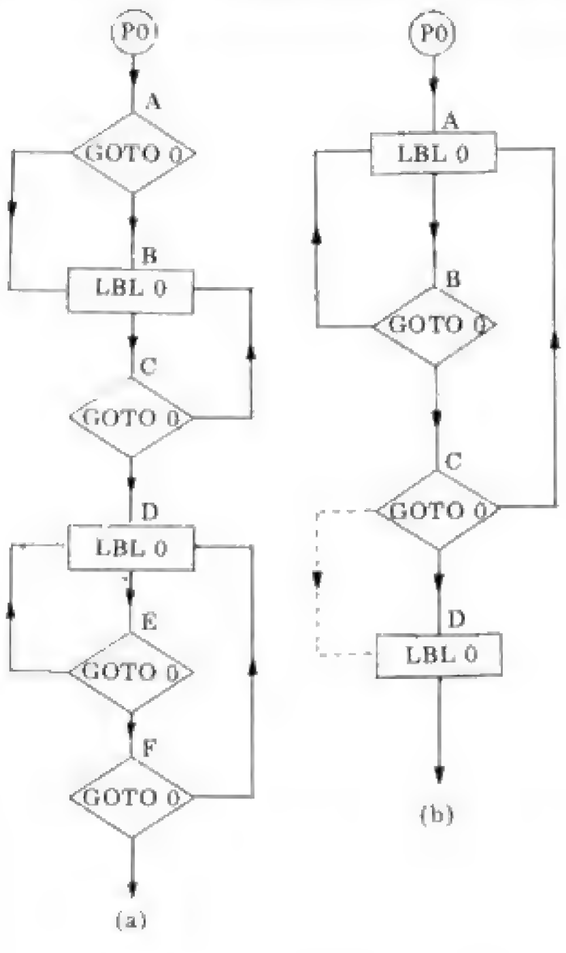


Fig 1. Multiple use of GOTO/LBL combinations. In Fig 1(a) execution will follow routes A-B, C-B, E-D and F-D. In Fig 1(b) the route C-D is invalid. NB, for convenience, the logical jump tests are not shown.

We deduce three programming rules:
1) The number of steps within a loop should be kept to a minimum, both to eliminate unnecessary repetition of steps and to reduce search time;
2) Labels may be used repeatedly as long as the logic is right.
3) Forward jumps should be avoided if at all possible.

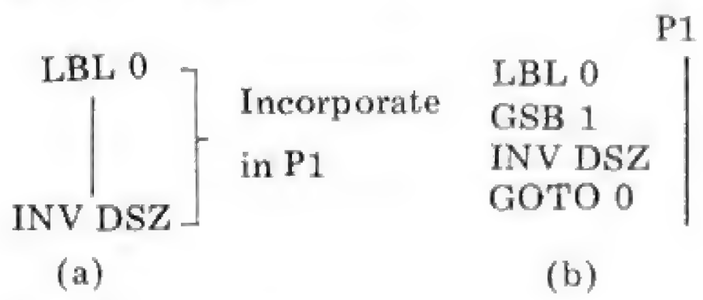


Fig 2 Use of subroutines to reduce loop read time. Replace (a) by the combination (b) with P1 placed near the beginning of the program stack.

Programming for speed

One method of reducing loop search time is to incorporate some or all of the contents of the loop in a subroutine. Figure 2 illustrates this and the table in Figure 4 shows that we may trade off GSB search steps against GOTO search steps in the ratio 10:9. So, in Figure 2(a), if the loop comprises 45 steps then a saving in read time will be made if the beginning of P1 can be located within the first 50 steps of the program stack. This analysis is rather crude in that it ignores the effect of P1 on the read time associated with lower priority programs and the resultant reduction in read time of other loops/jumps in the main program.

The problem of forward jumps is more difficult. Speeding up may result from a combination of forward and backward sequence programming. Figure 3(a) shows a logic structure forward programmed. Figure 3(b) shows the same sequence programmed in reverse. If we assume the GOTO 0/LBL 0 loop is to be repeated a large number of times and that the probability of $x \geqslant f$ in the GOTO 1/LBL 1 is p, then

GOTO page 158

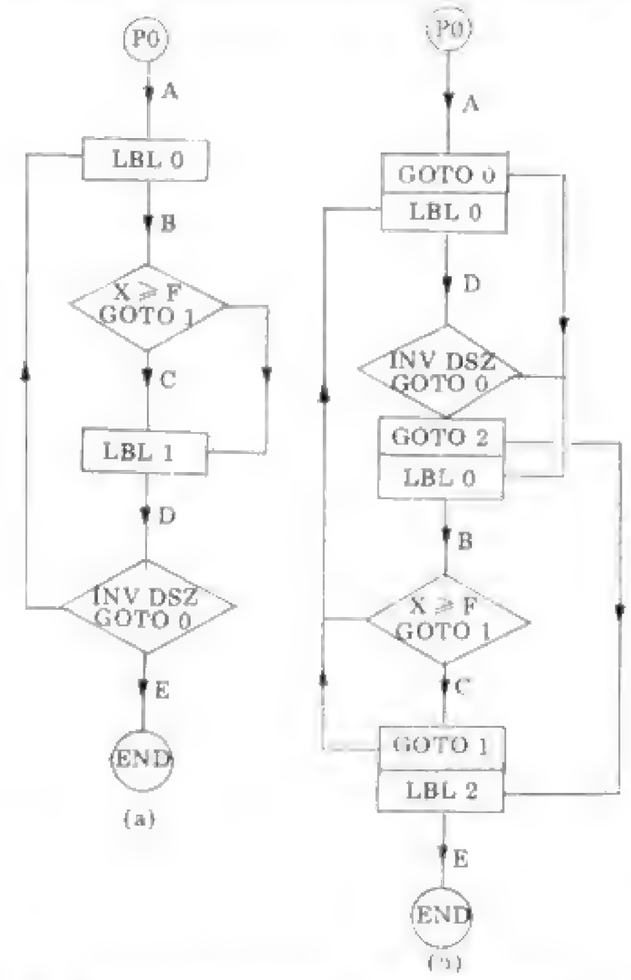


Fig 3. Reverse sequence programming. (a) Normal logic flow path; (b) Programmed in reverse sequence.



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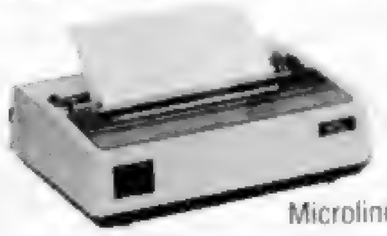
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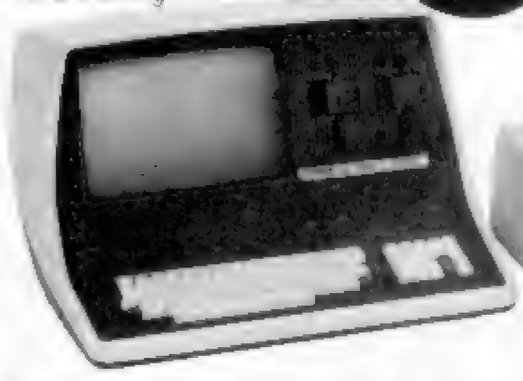
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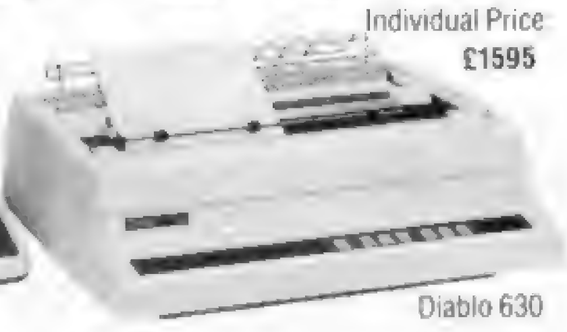
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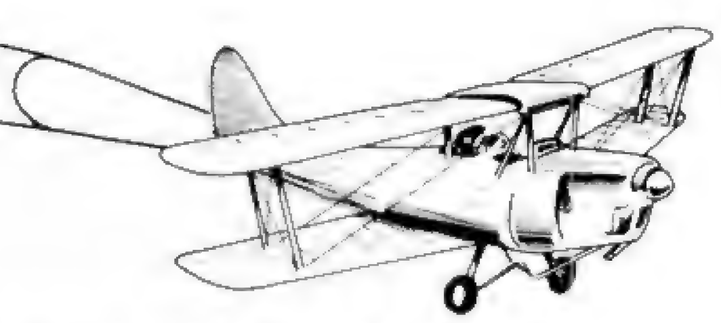
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This is our unique quick-reference guide, reprinted every month to help our readers pick their way through the most important pieces of (necessary) jargon found in PCW. While it's in no way totally comprehensive, we trust you'll find it a useful introduction. Happy microcomputing!

Welcome to the confusing world of the microcomputer. First of all, don't be fooled; there's nothing complicated about this business, it's just that we're surrounded by an immense amount of necessary jargon. Imagine if we had to continually say 'numbering system with a radix of 16 in which the letters A to F represent the values ten to 15' when instead we can simply say 'hex'. No doubt soon many of the words and phrases we are about to explain will eventually fall into common English usage. Until that time, *PCW* will be publishing this guide — every month.

We'll start by considering a microcomputer's functions and then examine the physical components necessary to implement these functions.

The microcomputer is capable of receiving information, *processing* it, storing the results or sending them somewhere else. All this information is called *data* and it comprises numbers, letters and special symbols which can be read by humans. Although the data are (yes, it's plural) accepted and output by the computer in 'human' form, inside it's a different story — they must be held in the form of an electronic code. This code is called *binary* — a system of numbering which uses only 0s and 1s. Thus in most micros each character, number or symbol is represented by eight binary digits or *bits* as they are called, ranging from 00000000 to 11111111.

To simplify communication between computers, several standard coding systems exist, the most common being *ASCII* (American Standard Code for Information Interchange). As an example of this standard, the number five is represented as 00110101 — complicated for humans, but easy for the computer! This collection of eight bits is called a *byte* and computer freaks who spend a lot of time messing around with bits and bytes use a halfway human representation called *hex*. The hex equivalent of a byte is obtained by giving each half a single character code (0—9,A—F): 0=0000, 1=0001, 2=0010, 3=0011, 4=0100, 5=0101 . . . . . E=1110 and F=1111. Our example of 5 is therefore 35 in hex. This makes it easier for humans to handle complicated collections of 0s and 1s. The machine detects these 0s and 1s by recognising different voltage levels.

The computer processes data by reshuffling, performing arithmetic on, or by comparing them with other data. It's the latter function that gives a computer its apparent 'intelligence' — the ability to make decisions and to act upon them. It has to be given a set of rules in order to do this and, once again, these rules are stored in *memory* as bytes. The rules are called *programs* and while they can be input in binary or hex (*machine code* programming), the usual method is to have a special program which translates English or near-English into machine code. This speeds programming considerably; the nearer the *programming language* is to English, the faster the programming time. On the other hand, program execution speed tends to be slower.

The most common microcomputer language is *Basic*. Program instructions are typed in at the keyboard, to be coded and stored in the computer's memory. To *run* such a program the computer uses an *interpreter* which picks up each English-type *instruction*, translates it into machine code and then feeds it into the *processor* for execution. It has to do this each time the same instruction has to be executed.

Two strange words you will hear in connection with Basic are *PEEK* and *POKE*. They give the programmer access to the memory of the machine. It's possible to read (PEEK) the contents of a byte in the computer and to modify a byte (POKE).

Moving on to *hardware*, this means the physical components of a computer system as opposed to *software* — the programs needed to make the system work.

At the heart of a microcomputer system is the central processing unit *(CPU)*, a single microprocessor chip with supporting devices such as *buffers*, which 'amplify' the CPU's signals for use by other components in the system. The packaged chips are either soldered directly to a printed circuit board *(PCB)* or are mounted in sockets.

In some microcomputers, the entire system is mounted on a single, large, PCB; in others a *bus system* is used, comprising a long PCB holding a number of interconnected sockets. Plugged into these are several smaller PCBs, each with a specific function — for instance, one card would hold the CPU and its support chips. The most widely-used bus system is called the *S100*.

The CPU needs memory in which to keep programs and data. Microcomputers generally have two types of memory, *RAM* (Random Access Memory) and *ROM* (Read Only Memory). The CPU can read information stored in RAM — and also put information into RAM. Two types of RAM exist — *static* and *dynamic*; all you really need know is that dynamic RAM uses less power and is less expensive than static, but it requires additional, complex, circuitry to make it work. Both types of RAM lose their contents when power is switched off, whereas ROM retains its contents permanently. Not surprisingly, manufacturers often store interpreters and the like in ROM. The CPU can only read the ROM's contents and cannot alter them in any way. You can buy special ROMs called *PROMs* (Programmable ROMs) and *EPROMs* (Erasable PROMs) which can be programmed using a special device; EPROMs can be erased using ultra-violet light.

Because RAM loses its contents when power is switched off, *cassettes* and *floppy disks* are used to save programs and data for later use. Audio-type tape recorders are often used by converting data to a series of audio tones and recording them; later the computer can listen to these same tones and re-convert them into data. Various methods are used for this, so a cassette recorded by one make of computer won't necessarily work on another make. It takes a long time to record and play back information and it's difficult to locate one specific item among a whole mass of information on a cassette; therefore, to overcome these problems, floppy disks are used on more sophisticated systems.

A floppy disk is made of thin plastic, coated with a magnetic recording surface rather like that used on tape. The disk, in its protective envelope, is placed in a disk drive which rotates it and moves a *read/write head* across the disk's surface. The disk is divided into concentric rings called *tracks*, each of which is in turn subdivided into *sectors*. Using a program called a *disk operating system*, the computer keeps track of exactly where information is on the disk and it can get to any item of data by moving the head to the appropriate track and then waiting for the right sector to come round. Two methods are used to tell the computer where on a track each sector starts: *soft sectoring* where special signals are recorded on the surface and *hard sectoring* where holes are punched through the disk around the central hole, one per sector.

Half-way between cassettes and disks is the *stringy floppy* — a miniature continuous loop tape cartridge, faster than a cassette but cheaper than a disk system. *Hard disk* systems are also available for microcomputers; they store more information than floppy disks, are more reliable and information can be transferred to and from them much more quickly.

You, the user, must be able to communicate with the computer and the generally accepted minimum for this is the visual display unit *(VDU)*, which looks like a TV screen with a typewriter-style *keyboard*; sometimes these are built into the system, sometimes they're separate. If you want a written record *(hard copy)* of the computer's output, you'll need a *printer*.

The computer can send out and receive information in two forms — *parallel* and *serial*. Parallel input/output *(I/O)* requires a series of wires to connect the computer to another device, such as a printer, and it sends out data a byte at a time, with a separate wire carrying each bit. Serial I/O involves sending data one bit at a time along a single piece of wire, with extra bits added to tell the receiving device when a byte is about to start and when it has finished. The speed that data is transmitted is referred to as the *baud rate* and, very roughly, the baud rate divided by ten equals the number of bytes being sent per second.

To ensure that both receiver and transmitter link up without any electrical horrors, standards exist for serial interfaces; the most common is *RS232* (or *V24*) while, for parallel interfaces to printers, the *Centronics* standard is popular.

Finally, a *modem* connects a computer, via a serial interface, to the telephone system allowing two computers with modems to exchange information. A modem must be wired into the telephone system and you need British Telecom's permission; instead you could use an *acoustic coupler*, which has two obscene-looking rubber cups into which the handset fits, and which has no electrical connection with the phone system — British Telecom isn't so uppity about the use of these.

DIRECT ACCESS

PACKAGES

PCW's 'Packages' section is produced bi-monthly, alternating with our 'In Store' hardware guide. We have confined coverage to business packages which are available and supported at national level and which have been in use for at least six months in a minimum of five sites. Producers of packages which fall within these constraints should send details or updates to: **Packages, *PCW*, 14 Rathbone Place, London W1P 1DE.**

The layout has been designed to allow you to discover which packages are available for the application you have in mind and to show you which packages are available for your computer if you already have a machine. In either case the code enables you to look up the supplier's name and telephone number in the table below.

All details published are the latest made available — some may have changed since this issue went to press.

Code	Company	Telephone
A1	ACT/Petsoft	021-454 5348
A2	Arden Data Processing	0533 22255
B1	B + B Computer Ltd.	0204 26644
B2	Beam Business Centre	01-636 1392
B3	Benchmark Computer Systems	0726 61000
B4	Bristol Software Factory	0272 23430
C1	CAP-CPP Products Ltd.	01-404 0911
C2	Commodore	01-388 5702
C3	Compsoft	0483 39665
C4	Comput-a-crop	01-499 6987
C5	Computastore Ltd.	01-499 6987
C6	Computech	01-794 0202
D1	Data Bank	0509 217671
G1	Graffcom Systems Ltd.	01-734 8862
G2	Grama (Winter) Ltd.	01-636 8210
G3	Great Northern	0532 589980
H1	A.J. Harding	0424 220391
H2	Hartford Software	0606 76265
H3	H.B. Computers	0536 83922
H4	Hipposoft	0332 23127
I1	Intereurope Software Design	0734 786644
I2	Intex Datalog Ltd	0642 781193
J1	T.V. Johnson	0276 62506
K1	Katanna Management Services	0245 76127
K2	Keen Computers	0602 583254
L1	Lifeboat Associates	01-836 4663
L2	Liveport (Exidy Sorcerer Firmware)	0736 798157
L3	Ludhouse (Computing) Ltd.	01-679 4321
M1	Micro Computer Applications Ltd.	0734 470425
P1	Padmede Computer Services	025671 2434
P2	Personal Computers Ltd.	01-626 8121
R1	Rockliff	051-521 5830
S1	SMG Micro Computers	0474 55813
S2	The Softwarehouse	01-637 2108
S3	Stage One Software	0202 23570
S4	Systematics International	0268 284601
S5	Sumlock Bondain	01-250 0505
T1	Tridata Micros Ltd.	021 622 1754
V1	Vlasak Electronics Ltd.	062-84 74789

Applications

Application	Machine	Price	Code
Appointments planner	Commodore/ Computhink	£100	S3
Assembler dev	PET/CBM	£50	L2
Bank accounts	Apple II	£10	D1
	Commodore/ Computhink	£100	S3
	ITT 2020	£10	D1
	PEt	£10	D1
Bonds/pension quotations	Commodore/ Computhink	£100	S3
Budgeting package	MCZ Zilog	£500 +	I1
Bureau de change	CBM	£8	H3
Cash flow	Apple II	£75	P2
	Apple II	£80	V1
	CP/M	£250	L3
	PET	£8	A1
Cash register	Apple II	£10	D1
	ITT 2020	£10	D1
	PET	£10	D1
CBasic	Tandy Model II	£70	M1
Company secretary	CP/M	£450	C4
Conference organiser	MCZ Zilog	£500 +	I1
Contract costing	CP/M	£2000	L3
CP/M & utilities	Tandy Model II	£150	M1
Credit control	Apple II	£98	P2
	PET	£650	B4
Database management/Information retrieval	ACT800	£225	H4
	Apple	£150	A2
	Apple	£150	K2
	Apple	£60-140	S2
	Apple	£150	S5
	Apple II	£98	P2
	Aple II/ITT 2020	£100	S4
	Commodore/ Computhink	£45-250	S3
	CP/M	£150-750	C4
	CP/M	£100	G3
	Cromemco	£250	B3
	North Star Horizon	£250	B3
	PET	£170	C3
	PET	£325	A1
	PET	£225	H4
	PET/CBM	£75	B1
	PET/CBM	£50/150	C2
	PET/CBM	£150	J1
	PET/CBM	£150	G2
	Tandy Model I	£25-80	M1
	TRS-80	£60	S2
	TRS-80	£150	J1
	TRS-80	£32.50	H1
	8000 Series	POR	C2
Disk operating system	PET/CBM	£150	B1
Estate agent	Apple	£850	A2
	Apple	£850	S5
	Apple	£850	K2
	Apple II	£175	P2
	Apple II/ITT 2020	£750	S4
	CBM	£30	H3
	Commodore/ Computhink	£250	S3
	CP/M	£750	C4
	PCC 2000 Simpelec Triton 3	£350	B3
	PET	£25	A1
Equipment lease/rent/ HP	CP/M	£400	G1
Financial modelling	CP/M	£400	G1
Financial planning	Apple II/ITT2020	£250	S4
General ledger/NL	Apple	£300	A2
	Apple	£300	S5
	Apple	£300	K2
	Apple II	£295	P2
	Apple II	£225	V1
	Apple II	£295	C6
	CBM	£200	H3
	Commodore/ Computhink	POR	S3
	CP/M	£500	L3
	CP/M	£500	K1
	CP/M	£375	L1
	CP/M	£500	C4
	CP/M	£400	G1
	Cromemco	£250	B3
	ITT 2020	£295	C6
	ITT 2020/Apple II	£250P	S4
	North Star Horizon	£250	B3
	PCC 2000 Simpelec Triton 3	£350	B2
	PET/CBM	£200	C2
	Tandy Model I	£90	M1
	Tandy Model II	£90	M1
	TRS-80	£225	H1
	TRS-80 I	£225/325	T1
	TRS-80 I	£325	K1
	TRS-80 II	£425	T1
	Vector	£400	C5
	8080/Z80	£357	L1
	8080/Z80	£275	G3
Hire purchase	Cromemco	£400 +	B3
Incomplete records	Apple	£250	S2
	Apple	POR	K2
	Apple II	£125	P2
	Commodore/ Computhink	£750	S3
	Tandy Model I	£40	M1
	TRS-80	£40	H1
Individual designed programs	TRS-80 I	£100 +	K1
Integrated Accts	Altos (CP/M, MP/M)	£300	B1
	Apple II	£450	P1
	Apple II	£340	P2
	Apple II	£855	V1
	Commodore/ Computhink	POR	S3
	CP/M	£950	L1
	CP/M	£1500	C4
	CP/M	£1100	G1
	Cromemco	£950	B3
	ITT 2020	£450	P1
	MZ-80K	£150	P2
	North Star Horizon	£950	B3
	PET/CBM	£300	B1
	PET/CBM	(£50)	C2
	PET/CBM	£650	J1
	PET/CBM	£650	G2
	Tandy Model I	£350	M1
	Tandy Model II	£350	M1
	TRS-80	£75	J1
	Vector	£1000	C5
	8000 Series	POR	C2
	8080/Z80	£950	L1
	8080/Z80	£995	G3
Investment portfolio	TRS-80	£20	S2
Invoicing	Apple	£295	S2
	Apple II	£300	P1
	Apple II	£125	P2
	Apple II	£140	V1
	Commodore/ Computhink	POR	S3
	CP/M	£500	K1
Job costing	Apple II	£125	P2
	Apple II	£300	P1
	CP/M	£700	C4
	ITT 2020	£300	P1
	Tandy Model I	POR	M1
	Tandy Model II	POR	M1
Job order control	8080/Z80	£275	G3
Leasing	Cromemco	£400 +	B3
Legal precedents	CP/M	£1100	C4
Letter writer	Apple II	£80	V1
Lisp	PET/CBM	£75	C2
Lotteries	PET	£45	H2
Mailing list	Altos (CP/M, MP/M)	£75	B1
	Apple	£300	A2
	Apple	£50-150	S2
	Apple	£300	S5
	Apple	£300	K2
	Apple II	£40	P2
	Apple II	£50	D1
	Apple II/ITT 2020	£100	S4
	CBM	£35	H3
	Commodore/ Computhink	£100	S3
	CP/M	£50-150	C4
	CP/M	£250	G1
	ITT 2020	£50	D1
	PET	£45	H2
	PET	£50	D1
	PET	£15	A1
	PET/CBM	£75	B1
	PET/8032	£75/150	S1
	Tandy Model I	£40	M1
	Tandy Model II	£75	M1
	TRS-80	£50-150	S2
	TRS-80	£25/38/55	H1
Mail shot	Apple	£14	S2
	Apple II	£225	P2
	Commodore/ Computhink	£125	S3
	CP/M	£200-360	C4
	MCZ Zilog	£250	I1
	PCC 2000 Simpelec Triton 3	£450	B2
	Tandy Model II	£75	M1
Membership accting	PET	£85	H2
Order entry/invoicing	CP/M	£350	G1
Order processing	CP/M	£550	L1
	8080/Z80	£550	L1
Office admin	Apple II/ITT 2020	£100	S4
Pad to plotter systems	Apple II	£250	P2
Pascal	PET/CBM	£120	C2
Payroll	Apple	POR	A2
	Apple	£200	S2
	Apple	POR	S5
	Apple	POR	K2
	Apple II	£200	P2
	Apple II	£375	V1
	Apple II	£375	C6
	Apple II	£10	D1
	Apple II/ITT 2022	£250P	S4
	CBM	£10	H3
	CP/M	£450	L3
	CP/M	£500	K1
	CP/M	£475	L1
	CP/M	£495	C4
	CP/M	£500	G1
	Cromemco	£350	B3
	ITT 2020	£375	C6
	ITT 2020	£10	D1
	North Star Horizon	£350	B3
	PET	£200/350	C5
	PET	£50/25/ 195	A1
	PET	£50/195	I2
	PET	£10	D1
	PET/CBM	£150	G2
	PET/CBM	£150	J1
	PET/CBM	£150	C2
	Sorcerer	£250	L2
	Tandy Model I	£249	M1
	TRS-80	£200	H1
	TRS-80I	£218	K1
	TRS-80I	£218	T1
	TRS-80II	£375	T1
	8000 Series	£250	C2
	8080/Z80	£475	L1
	8080/Z80	£275	G3
Personnel records	Apple II	£98	P2
	CP/M	£450	C4
	MCZ Zilog	£500 +	I1
	PET	£85	H2

PACKAGES

DIRECT ACCESS

Application	Machine	Price	Code
Petaid report generator	Commodore/ Computhink	£125	S3
Petsoft programs	PET/CBM	£160	J1
Planning/Maintenance	PET/8032	£595	S1
Postal advertising response package	Apple	£350	S2
PR/advertising package	Commodore/ Computhink	£1000	S3
Price lister	CBM	£12	H3
Printers job control	Commodore/ Computhink	£250	S3
Production analysis	Apple II	£75	P2
	CP/M	£700	C4
	PET/CBM	£300	B1
Prof appts groups	8080/Z80	£275	G3
Prof appts individ	8080/Z80	£220	G3
Prof client billing	8080/Z80	£330	G3
Programming aids	Apple II	£40	P2
Property management	CP/M	£450-1000	C4
Purchase ledger	Apple	£300	A2
	Apple	£300	S5
	Apple	£300	K2
	Apple II	£295	C6
	Apple II	£300	P1
	Apple II	£295	P2
	Apple II	£315	V1
	Apple II/ITT 2020	£250P	S4
	CBM	£350	H3
	Commodore/ Computhink	POR	S3
	CP/M	£500	C4
	CP/M	£450	G1
	CP/M	£500	L3
	CP/M	£500	K1
	CP/M	£425	L1
	Cromemco	£250	B3
	ITT 2020	£295	C6
	ITT 2020	£300	P1
	North Star Horizon	£250	B3
	PCC 2000 Simpelec Triton 3	£350	B2
	PET	£300	B4
	PET	£95/120/ 350	A1
	PET/CBM	£200	C2
	PET/CBM	POR	J1
	PET/8032	£395	S1
	Tandy Model I	£90	M1
	Tandy Model II	£90	M1
	TRS-80	£225	H1
	TRS-80I	£225	T1
	TRS-801	£225	K1
	TRS-80II	£375	T1
	Vector	£400	C5
	8000 Series	£250	C2
	8080/Z80	£275	G3
	8080/Z80	£425	L1
Revolving credit	Cromemco	£400+	B3
Sales ledger	Apple	£300	A2
	Apple	£300	S5
	Apple	£300	K2
	Apple II	£295	C6
	Apple II	£300	P1
	Apple II	£295	P2
	Apple II	£315	V1
	Apple II/ITT 2020	£250P	S4
	CBM	£350	H3
	Commodore/ Computhink	POR	S3
	CP/M	£500	C4
	CP/M	£450	G1
	CP/M	£500	L3
	CP/M	£500	K1
	CP/M	£425	L1
	Cromemco	£250	B3
	ITT 2020	£295	C6
	ITT 2020	£300	P1
	North Star Horizon	£250	B3
	PCC 2000 Simpelec Triton 3	£350	B2
	PET	£300	B4
	PET	£800	C1
	PET	£95/350	A1
	PET/CBM	POR	J1
	PET/CBM	£200	C2
	PET/8032	£395	S1
	Tandy Model I	£90	M1
	Tandy Model II	£90	M1
	TRS-80	£225	H1
	TRS-80I	£225	T1
	TRS-801	£225	K1
	TRS-80II	£375	T1
	Vector	£400	C5
	8000 Series	£250	C2
	8080/Z80	£275	G3
	8080/Z80	£425	L1
Salesman	Apple II	£10	D1
	ITT 2020	£10	D1
	PET	£10	D1
Screen generator	MCZ Zilog	£75+	I1
S/L, P/L & stock control	CP/M	£1000	L3
Solicitor's complete record accounting	Apple	£3000	S2
Solicitor's package	PET/8032	£750	S1
Statistics	Apple	£150	G3
	Apple II	£100-195	P2
	TRS-80	£45	S2
Stock control/ recording	Altos (CP/M, MP/M)	£300	B1
	Apple	POR	A2
	Apple	POR	K2
	Apple	POR	S5
	Apple	£150	G3
	Apple	£80	S2
	Apple II	£35/98	P2
	Apple II	£10	D1
	Apple II	£285	V1
	Apple II	£300	P1
	Apple II/ITT 2020	£500	S4
	CBM	£35/25	H3
	Commodore/ Computhink	£100/250	S3
	CP/M	£500	K1
	CP/M	£325	L1
	CP/M	£500-1500	C4
	CP/M	£350	G1
	Cromemco	£450	B3
	ITT 2020	£10	D1
	ITT 2020	£300	P1
	MZ-80K	£150	P2
	North Star Horizon	£450	B3
	PCC 2000 Simpelec Triton 3	£350	B2
	PET	£12/25/ 350	A1
	PET	£10	D1
	PET	£195	I2
	PET	£300	B4
	PET	£15	A2
	PET/CBM	£300	B1
	PET/CBM	£150	C2
	PET/CBM	£150	J1
	PET/CBM	£150	G2
	PET/Computhink	£250	R1
	PET/8032	£395	S1
	Tandy Model I	£30-50	M1
	Tandy Model II	£300	M1
	TRS-80	£48	S2
	TRS-80	£200	H1
	TRS-80	£115	J1
	TRS-80I	£200	K1
	TRS-80I	£200	T1
	TRS-80II	£375	T1
	8080/Z80	£275	G3
	8080/Z80	£325	L1
TAP business system	PET	£125	H2
Text file librarian	Apple II/ITT 2020	£125	S4
Time/cost recording	Apple	£450	S2
	Apple II	£300	P1
	Apple II	£125	P2
	Commodore/ Computhink	POR	S3
	CP/M	£400	G1
	Cromemco	£250	B3
	ITT 2020	£300	P1
	North Star Horizon	£250	B3
	PCC 2000 Simpelec Triton 3	£350	B2
	PET/CBM	£300	B1
	Tandy Model I	POR	M1
	Tandy Model II	POR	M1
Utilities	Apple II	£20	C6
	ITT 2020	£20	C6
Utility set	CBM	£78	H3
VAT	PET	£17.50	A1
VAT master	CBM	£25	H3
VAT register	TRS-80	£15	H1
Vet package	PET/8032	POR	S1
Video message	Apple	£200	G3
Warehousing	PET/8032	POR	S1
Word processing	ACT 800	£375	H4
	Apple	£60	S2
	Apple	£75	K2
	Apple	£75	S5
	Apple	£75	A2
	Apple II	£150-300	P2
	Apple II	£75	J1
	Apple II	£120	V1
	Apple II	£40	D1
	Apple II/ITT 2020	£180/95	S4
	CBM	£35	H3
	Commodore/ Computhink	£120	S3
	CP/M	£500	K1
	CP/M	£150-260	C4
	CP/M	£400	G1
	ITT 2020	£40	D1
	MCZ Zilog	£500+	I1
	PET	£85/65/ 40/20	H2
	PET	£40	D1
	PET	£375	H4
	PET	£25/325	A1
	PET	£325	C5
	PET/CBM	£75/150	C2
	PET/CBM	£75/150	J1
	PET/CBM	£75/150	G2
	Tandy Model I	£50/75	M1
	Tandy Model II	£175-240	M1
	TRS-80	£30/60/90	S2
	TRS-80	£45/95	J1
	TRS-80	£15	H1
	TRS-80I	£70	K1
	Vector	£400	C5
	8000 Series	£250	C2

Machines

Machine	Application	Price	Code
ACT 800	Database management/	£225	H4
	Word processing	£375	H4
Altos (CP/M, MP/M)	Integrated accts	£300	B1
	Mailing list	£75	B1
	Stock control/recording	£300	B1
Apple	Database management/ information retrieval	£150	K2
	Database management/ information retrieval	£150	A2
	Database management/ information retrieval	£60-140	S2
	Database management/ information retrieval	£150	S5
	Estate agent	£850	S5
	Estate agent	£850	A2
	Estate agent	£850	K2
	General ledger/NL	£300	K2
	General ledger/NL	£300	A2
	General ledger/NL	£300	S5
	Incomplete records	POR	K2
	Incomplete records	£250	S2
	Invoicing	£295	S2
	Job costing	£450	S2
	Mailing list	£300	K2
	Mailing list	£300	A2
	Mailing list	£50-150	S2
	Mailing list	£300	S5
	Mail shot	£14	S2
	Payroll	POR	S5
	Payroll	POR	K2
	Payroll	POR	A2
	Payroll	£200	S2
	Postal advertising response package	£350	S2
	Purchase ledger	£300	K2
	Purchase ledger	£300	A2
	Purchase ledger	£300	S5
	Sales ledger	£300	A2
	Sales ledger	£300	K2
	Sales ledger	£300	S5
	Solicitor's complete record accounting	£3000	S2
	Statistics	£150	G3
	Stock control/recording	£150	G3
	Stock control/recording	POR	K2
	Stock control/recording	POR	A2
	Stock control/recording	£80	S2
	Stock control/recording	POR	S5
	Time/cost recording	£450	S2
	Video message	£200	G3
	Word processing	£75	K2
	Word processing	£75	A2
	Word processing	£60	S2
	Word processing	£75	S5
Apple II	Bank account	£10	D1
	Cash flow	£80	V1
	Cash flow	£75	P2
	Cash register	£10	D1
	Credit control	£98	P2
	Database management/ information retrieval	£98	P2
	Estate agent	£175	P2
	General ledger/NL	£225	V1
	General ledger/NL	£295	P2
	General ledger/NL	£295	C6
	Incomplete records	£125	P2
	Integrated accts	£855	V1
	Integrated accts	£450	P1
	Integrated accts	£340	P2
	Invoicing	£140	V1
	Invoicing	£300	P1
	Invoicing	£125	P2
	Job costing	£125	P2
	Job costing	£300	P1
	Letter writer	£80	V1
	Mailing list	£50	D1
	Mailing list	£40	P2
	Mail shot	£225	P2
	Pad to plotter system	£250	P2
	Payroll	£375	V1
	Payroll	£200	P2
	Payroll	£375	C6
	Payroll	£10	D1
	Personnel records	£98	P2
	Production analysis	£75	P2
	Programming aids	£40	P2
	Purchase ledger	£315	V1
	Purchase ledger	£300	P1
	Purchase ledger	£295	P2
	Purchase ledger	£295	C6
	Sales ledger	£315	V1
	Sales ledger	£300	P1
	Sales ledger	£295	P2
	Sales ledger	£295	C6
	Sales ledger	£295	P2
	Sales ledger	£295	C6
	Salesman	£10	D1
	Statistics	£100-195	P2
	Stock control/recording	£285	V1
	Stock control/recording	£300	P1
	Stock control/recording	£35/98	P2
	Stock control/recording	£10	D1
	Time/cost recording	£300	P1
	Time/cost recording	£125	P2
	Utilities	£20	C6
	Word processing	£120	V1
	Word processing	£150-300	P2
	Word processing	£40	D1
	Word processing	£75	J1
Apple II/ ITT 2020	Database management/ information retrieval	£100	S4
	Estate agent	£750	S4
	Financial planning	£250	S4
	General ledger/NL	£250P	S4
	Mailing list	£100	S4
	Office admin	£100	S4
	Payroll	£250P	S4
	Purchase ledger	£250P	S4

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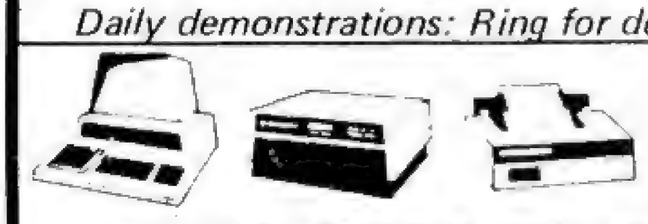
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PACKAGES

DIRECT ACCESS

Machine	Application	Price	Code
	Sales ledger	£250P	S4
	Stock control/recording	£500	S4
	Text file librarian	£125	S4
	Word processing	£180/95	S4
CBM	Bureau de change	£8	H3
	Estate agent	£30	H3
	General ledger/NL	£200	H3
	Mailing list	£35	H3
	Payroll	£10	H3
	Price lister	£12	H3
	Purchase ledger	£350	H3
	Sales ledger	£350	H3
	Stock control/recording	£35/25	H3
	Utility set	£78	H3
	VAT master	£25	H3
	Word processing	£35	H3
Commodore/ Computhink	Appointments planner	£100	S3
	Bank accounts	£100	S3
	Bonds/pension quotations	£100	S3
	Database management/ information retrieval	£45-250	S3
	Estate agent	£250	S3
	General ledger/NL	POR	S3
	Incomplete records	£750	S3
	Integrated accts	POR	S3
	Invoicing	POR	S3
	Mailing list	£100	S3
	Mail shot	£125	S3
	Petaid report generator	£125	S3
	PR/advertising package	£1000	S3
	Printers job control	£250	S3
	Purchase ledger	POR	S3
	Sales ledger	POR	S3
	Stock control/recording	£100/250	S3
	Time/cost recording	POR	S3
	Word processing	£120	S3
CP/M	Cash flow	£250	L3
	Company secretary	£450	C4
	Contract costing	£2000	L3
	Database management/ information retrieval	£150-750	C4
	Database manatement/ information trerieval	£100	G3
	Equipment lease/rent/ HP	£400	G1
	Estate agents	£750	C4
	Financial modelling	£400	G1
	General ledger/NL	£500	L3
	General ledger/NL	£500	C4
	General ledger/NL	£400	G1
	General ledger/NL	£500	K1
	General ledger/NL	£375	L1
	Integrated accts	£1500	C4
	Integrated accts	£1100	G1
	Integrated accts	£950	L1
	Invoicing	£325	L1
	Invoicing	£150-350	C4
	Invoicing	£500	K1
	Job costing	£700	C4
	Legal precedents	£1100	C4
	Mailing list	£50-150	C4
	Mailing list	£250	G1
	Mail shot	£200-360	G4
	Order entry/invoicing	£350	G1
	Order processing	£550	L1
	Payroll	£450	L3
	Payroll	£495	C4
	Payroll	£500	G1
	Payroll	£500	K1
	Payroll	£475	L1
	Personnel records	£450	C4
	Production analysis	£700	C4
	Property management	£450-1000	C4
	Purchase ledger	£500	L3
	Purchase ledger	£450	G1
	Purchase ledger	£500	K1
	Purchase ledger	£425	L1
	Purchase ledger	£500	C4
	Sales ledger	£500	L3
	Sales ledger	£500	C4
	Sales ledger	£450	G1
	Sales ledger	£500	K1
	Sales ledger	£425	L1
	S/L, P/L + stock control	£1000	L3
	Stock control/recording	£325	L1
	Stock control/recording	£500-1500	C4
	Stock control/recording	£350	G1
	Stock control/recording	£500	K1
	Time/cost recording	£400	G1
	Word processing	£500	K1
	Word processing	£400	G1
	Word processing	£150-260	C4
Cromemco	Database management/ information retrieval	£250	B3
	General ledger/NL	£250	B3
	Hire purchase	£400+	B3
	Integrated accts	£950	B3
	Invoicing	£100	B3
	Leasing	£400+	B3
	Purchase ledger	£250	B3
	Revolving credit	£400+	B3
	Sales ledger	£250	B3
	Stock control/recording	£450	B3
	Time/cost recording	£250	B3
ITT 2020	Bank account	£10	D1
	Cash register	£10	D1
	General ledger/NL	£295	C6
	Integrated accts	£450	P1
	Invoicing	£300	P1
	Job costing	£300	P1
	Mailing list	£50	D1
	Payroll	£10	D1
	Payroll	£375	C6
	Purchase ledger	£300	P1
	Purchase ledger	£295	C6
	Sales ledger	£300	P1
	Sales ledger	£295	C6

Machine	Application	Price	Code
	Salesman	£10	D1
	Stock control/recording	£10	D1
	Stock control/recording	£300	P1
	Time/cost recording	£300	P1
	Utilities	£20	C6
	Word processing	£40	D1
MCZ Zilog	Budgeting package	£500+	I1
	Conference organiser	£500+	I1
	Mail shot	£200	I1
	Personnel records	£500+	I1
	Screen generator	£75+	I1
	Word processing	£500+	I1
MZ-80K	Integrated accounts	£150	P2
	Stock control/recording	£150	P2
North Star Horizon	Database management/ information retrieval	£250	B3
	General ledger/NL	£250	B3
	Integrated accts	£950	B3
	Invoicing	£100	B3
	Payroll	£350	B3
	Purchase ledger	£250	B3
	Sales ledger	£250	B3
	Stock control/recording	£450	B3
	Time/cost recording	£250	B3
PCC 2000 Simpelec Triton 3	Estate Agent	£350	B2
	General ledger/NL	£350	B2
	Mail shot	£450	B2
	Purchase ledger	£350	B2
	Sales ledger	£350	B2
	Stock control/recording	£350	B2
	Time/cost recording	£350	B2
PET	Bank account	£10	D1
	Cash flow	£8	A1
	Cash register	£10	D1
	Credit control	£650	B4
	Database management/ information retrieval	POR	C1
	Database management/ information retrieval	£325	A1
	Database management/ information retrieval	£225	H4
	Database management/ information retrieval	£170	C3
	Estate agent	£25	A1
	General ledger/NL	£1000	C1
	Invoicing	£350	A1
	Invoicing	£400	C1
	Lotteries	£45	H2
	Mailing list	£15	A1
	Mailing list	£50	D1
	Mailing list	£45	H2
	Membership accting	£85	H2
	Payroll	£50/195	I2
	Payroll	£10	D1
	Payroll	£50/25/ 195	A1
	Payroll	POR	C1
	Payroll	£200/350	C5
	Personnel records	£85	H2
	Purchase ledger	£95/120/ 350	A1
	Purchase ledger	£1000	C1
	Purchase ledger	£300	B4
	Sales ledger	£300	B4
	Sales ledger	£800	C1
	Sales ledger	£95/350	A1
	Salesman	£10	D1
	Stock control/recording	£195	I2
	Stock control/recording	£10	D1
	Stock control/recording	£12/25/ 350	A1
	Stock control/recording	£15	A2
	Stock control/recording	£300	B4
	TAP business system	£125	H2
	VAT	£17.50	A1
	Word processing	£40	D1
	Word processing	£85/65/ 40/20	H2
	Word processing	£375	H4
	Word processing	£25/325	A1
	Word processing	325	C5
PET/CBM	Assembler dev	£50	C2
	Database management/ information retrieval	£75	B1
	Database management/ information retrieval	£50/150	C2
	Database management/ information retrieval	£150	G2
	Database management/ information retrieval	£150	J1
	Disk operating system	£150	B1
	General ledger/NL	£200	C2
	Integrated accts	£300	B1
	Integrated accts	£(50)	C2
	Integrated accts	£650	G2
	Integrated accts	£650	J1
	Invoicing	POR	J1
	Invoicing	£25-50	B1
	Lisp	£75	C2
	Mailing list	£75	B1
	Pascal	£120	C2
	Payroll	£150	G2
	Payroll	£150	J1
	Payroll	£150	C2
	Petsoft programs	£160	J1
	Production analysis	£300	B1
	Purchase ledger	£200	C2
	Purchase ledger	POR	J1
	Sales ledger	POR	J1
	Sales ledger	£200	J1
	Stock control/recording	£150	C2
	Stock control/recording	£300	B1
	Stock control/recording	£150	G2
	Stock control/recording	£150	J1
	Time/cost recording	£300	B1
	Word processing	£75/150	J1
	Word processing	£75/150	G2
	Word processing	£75/150	C2

Machine	Application	Price	Code
PET/ Computhink	Stock control/recording	£250	R1
PET/8032	Mailing list	£75/150	S1
	Planning maintenance	£595	S1
	Purchase ledger	£395	S1
	Sales ledger	£395	S1
	Solicitor's package	£750	S1
	Stock control/recording	£395	S1
	Vet package	POR	S1
	Warehousing	POR	S1
Sorcerer	Payroll	£250	L2
Tandy Model I	Database management/ information retrieval	£25-80	M1
	General ledger/NL	£90	M1
	Incomplete records	£40	M1
	Integrated accts	£350	M1
	Invoicing	£90	M1
	Job costing	POR	M1
	Mailing list	£40	M1
	Payroll	£249	M1
	Purchase ledger	£90	M1
	Sales ledger	£90	M1
	Stock control/recording	£30-50	M1
	Time/cost recording	POR	M1
	Word processing	£50/75	M1
Tandy Model II	CBasic	£70	M1
	CP/M + utilities	£150	M1
	General ledger/NL	£90	M1
	Integrated accts	£350	M1
	Invoicing	£90	M1
	Job costing	POR	M1
	Mailing list	£75	M1
	Mail shot	£75	M1
	Purchase ledger	£90	M1
	Sales ledger	£90	M1
	Stock control/recording	£300	M1
	Time/cost recording	POR	M1
	Word processing	£175-240	M1
TRS-80	Database management/ information retrieval	£60	S2
	Database management/ information retrieval	£32.50	H1
	Database management/ information retrieval	£150	J1
	General ledger/NL	£225	H1
	Incomplete records	£40	H1
	Integrated accts	£75	J1
	Investment portfolio	£20	S2
	Invoicing	£25	H1
	Mailing list	£25/38/ 55	H1
	Mailing list	£50-150	S2
	Payroll	£200	H1
	Purchase ledger	£225	H1
	Sales ledger	£225	H1
	Statistics	£45	S2
	Stock control/recording	£200	H1
	Stock control/recording	£48	S2
	Stock control/recording	£115	J1
	VAT register	£15	H1
	Word processing	£45/95	J1
	Word processing	£15	H1
	Word processing	£30/60/ 90	S2
TRS-80II	General ledger/NL	£425	T1
	Invoicing	£125	T1
	Payroll	£375	T1
	Purchase ledger	£375	T1
	Sales ledger	£375	T1
	Stock control/recording	£375	T1
Vector	General ledger/NL	£400	C5
	Integrated accts	£1000	C5
	Purchase ledger	£400	C5
	Sales ledger	£400	C5
	Word processing	£40	C5
8000 Series	Database management/ information retrieval	POR	C2
	Integrated accts	POR	C2
	Payroll	£250	C2
	Purchase ledger	£250	C2
	Sales ledger	£250	C2
	Word processing	£250	C2
8080/Z80	General ledger/NL	£275	G3
	General ledger/NL	£375	L1
	Integrated accts	£950	L1
	Integrated accts	£995	G3
	Invoicing	£325	L1
	Job order control	£257	G3
	Order processing	£550	L1
	Payroll	£475	L1
	Payroll	£275	G3
	Prof appts groups	£275	G3
	Prof appts individ	£220	G3
	Prof client billing	£330	G3
	Purchase ledger	£425	L1
	Purchase ledger	£275	G3
	Sales ledger	£275	G3
	Sales ledger	£425	L1
	Stock control/recording	£325	L1
	Stock control/recording	£275	G3

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ZX80. . . Sinc built, PSU, manual, leads, tapes, book of 30 progs, 3m old, good cond, £85. Tel Peacehaven 3222.

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ZX80. . . 6 wks old, Sinc built, all leads, PSU, manual, tape with games if req, £75. Tel 01-708 1703 after 4.

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PET 8k. . . small keybrd, exc cond, soundbox, dust cover, s/ware inc m/c Space Invaders, £390. Mr K Hashimoto, 16 Hartland Rd, Epping, Essex.

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AIM. . . Rockwell Exorciser-compat exp board, all documentation plus 3 new (Vector Inc) prototyping boards for AIM or Motorola systems, cost over £200, £80 complete or sell separately. Tel: Mike Grimwood, Royston (0763) 60762 after 7.

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ASR-33 Teletype. . . with paper tape punch & stand, in good cond, £220 ono. DEC RK-8 12 Mbyte disk drive in good order with manuals, £400 ono. Tel: 0206 45099.

Olivetti TE338. . . terminal, 110 baud, RS232 full duplex int, 120 col carriage, paper tape punch & reader, roll or pin feed, good working order, can deliver most areas, £185. Tel: 0670 712624 eves.

Casio fx502p. . . good cond, prog library, instruction book, original box, £60ono. Tel: 021-355 5458 after 5.

UK101. . . 8k RAM, cased & fully working with software, £220 ono. Tel: 041-942 8813.

UK101. . . new monitor in ROM with orig instruction sheet, £16. Tel: Dave, 0442 42603.

UK101. . . 8k RAM, new monitor chip, cased, plenty of games inc 'Space Invaders', books inc 'Programming the 6502' and '6502 Applications', all with cassette recorder, £300. Tel: 051-724 5563 eves.

Hardware/software. . . for TI58C prog calc, eg cass int, printer port, any hardware adds/peripherals. Tel: Rob, 061-445 9385 after 6.

FA1. . . cass int for fx501/2p, also Sharp MZ-80K. Tel: Burgh Heath 57327.

Two VDUs. . . (Hazeltine or Pericom), One TUART S100 I/O board, one day/date S100 clock boards, and 2 DMB6400 S100 64k RAM boards. Harold Easton, 7 Ingrebourde House, Broadley St., London NW8, tel: 01-723 5822.

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Video Genie. . . 16k, 4 months old, plus manuals and some games tapes, (StarTrek, Super Nova & Galaxy Invasion), £300. Tel: Crawley 35003.

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Acorn Atom. . . 5 months old, hardly used, can be seen working, £150. Tel: Coventry 62038 eves, Mon-Thurs only.

Philips G7000. . . Videopac computer, takes cassettes, range of about 35, complete with 2 cassettes & hand controls, cost £100 new, will exchange for ZX80 or sell £70 ono. Tel: Clitheroe 24336.

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MK14. . . RAM I/O, extra opt RAM, SoC revised monitor, cass int, £40. Steve Birch, 18 Eardisley Rd, Allerton, Liverpool L18 0HS.

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FREE 2001-8k PET. . . to anyone who'll give me £325 for my sound box!. Lots of software thrown in as well! Also — Epson TX80 printer with PET interface & cable (usually £60 extra on top of advertisers prices!), offers around £340 on 01-886 7354.

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Anadex DP-8000 . . . printer with Bailey IEEE — RS232 interface, suit PET and disk system, complete with manual, leads and plugs, £400 ono. J Nuttall, St John's Seminary, Wonersh, Guildford, Surrey. Will gladly demo.

Nascom 2. . . 32k RAM, built by Interface, NASPEN, TOOLKIT, Graphics ROM, Kenilworth case, 8 months old, inc tape rec, portable TV, Creed 7E teleprinter with interface and software, taped software, two programming books and INMC publications. Cost over £800 new, yours for £600. Tel: Bourne End (062 85) 23454.

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Apple accessories. . . Videx keyboard enhancer, £80; Supertalker, £148; M&R Sup-R Fan, £39; Tractor for Microline-80 Printer, £37; Bit copier ('Locksmith'), £99; Smart-Term 80 column board, £185; Z-80 Softcard, £165; Applesoft firmware card, £90. Tel: Cobham (Surrey) 5371

UK101. . . 8k RAM, Microtype 3 case, sound board, new monitor, 1 or 2 MHz switch, leads & documentation + dozens of tapes, perfect operation, £250 negotiable. Also Creed 3B printer + interface for UK101 £80 + carriage. Tel: 041 956 1768.

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ZX80. . . 2 months old, VGC inc Basic manual, all leads and mains adaptor, £75. Tel Abingdon 24762.

Chess Challenger 7... little used, £75 ono with mains adaptor. P Stilliard, 55 Morley Rd, Twickenham. Tel: 01-892 1909

Sinclair. . . 3k RAM expansion for ZX80. Only £22. Tel: 0256 75717.

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ZX80. . . Sinclair built, inc all leads, adaptor & manual, still in maker's box, only 2 months old, works perfectly, bargain at only £75 (cost £100), inc postge. Tel: 01-571 4461 (eve) ask for Tarik.

Micro Technology. . . K-1007-1 interface for use between old style PET and MTU high resolution graphics and other boards, £30. Tel: 01-398 2902 evenings after 8/weekends. Copy manual available to check suitability.

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ZX80. . . with 8k expansion, manual and all leads, cassette of utility programs (inc machine-code driven display) and user club magazines, £50. Tel: 061-773 6468

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UK101. . . 8k RAM, new and old monitors plus documentation, 1/2 MHz and 300/600 baud cassette I/F both switchable, cased, blower fan, power supply mounted seperately, utilities and games on tape including Basic line renumber and m/c code Invaders, £220. Phone Hemel Hempstead (0442) 45014.

Acorn Atom 12k+12k. . . with PSU manual, leads etc, fully assembled and tested, in pristine condition, £255. Tel: St Mary Bourne 424.

TRS-80 L2 16k. . . inc manuals, T-bug, editor/assembler, instant sort/search database, sargonii, startrek, backgammon, £300 the lot. Buyer collects. Phone 01-906 1966 eve.

ZX80. . . Fully ass, working, inc. manual, mains adaptor, all leads 'Magic Book', £90. M Grant, 1 Craigpark Rd, Scalloway, Shetland. Tel: 595 88 394 after 6.

CEGMON. . . for 32 line UK101, £25. With 32 line conversion £33. Also 16 line Compshop New Monitor £15. T Kenahan, 109 Devonshire Drive, North Anston, Sheffield, Yorks. Tel: Rotherham 60166 ext 3250 (office hours)

ZX80. . . complete (all leads, manual, adaptor), Sinc built, several progs, £50. R J Hollick, 34 Woodvale Rd, Gurnard, Isle of Wight.

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S100 16k. . . Static RAM boards (2114) with bank select £120 each (2); S100 Ithaca Audio disk board, untested, so £75. ono. INS 8295 (NIBL) £15 ea; 2102's, £2.50 per 8. Tel Dave, 02367 36570 after 6.

TRS-80 48k. . . with twin 125k drives using Newdos-plus, all manuals including TRSDOS and tape EDT/ASS, virtually unused, £1100 ono. Caterham (0883) 47320 evenings, Brighton (0273) 559711 ext 39 ask for Jim.

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Olympia type SGE 50. . . input/output typewriter with interface boards and multi-way plug, £120 ono. Bowmansgreen 23824 (St Albans).

Ohio Scientific Superboard IIE . . . (32x48 format) 8k RAM, AY-8910 programmable synthesiser, power supply, cassette recorder, some tapes and an ASR33 teleprinter which needs an interface, £300 ono the lot. Contact Gino Masoero on 01-759 2811 Ex 41 working hours.

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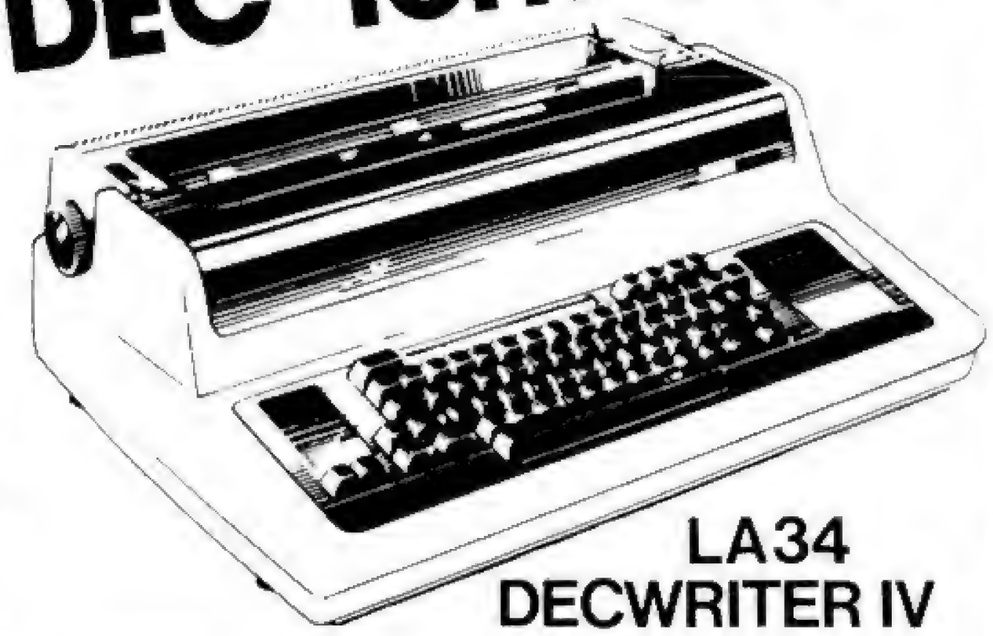
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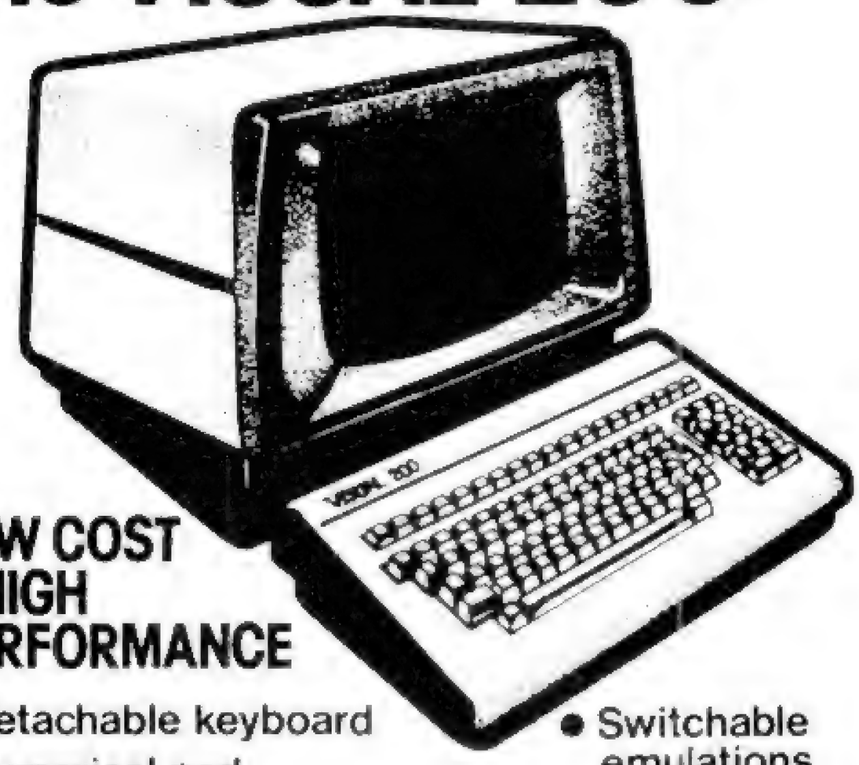
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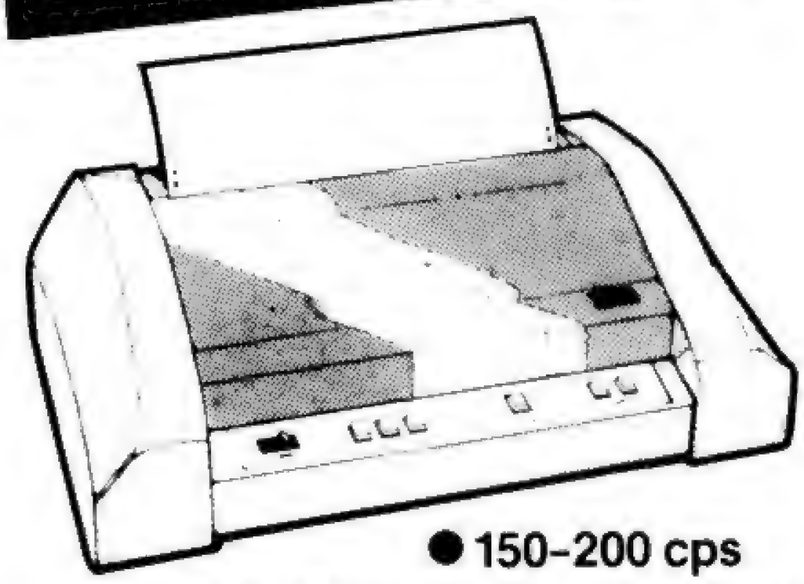
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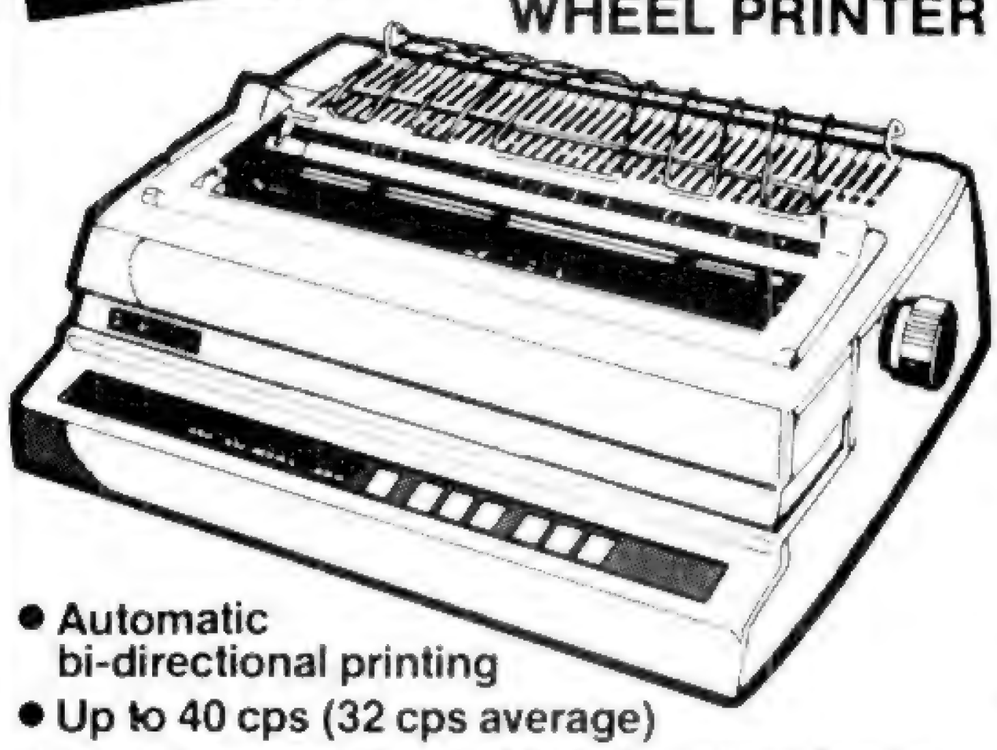
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ZX80 1k. . . fully assembled (in box) with manual, mains adaptor and leads, as new, £55. Tel: 051-648 4362.

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ZX80. . . Sinc built, boxed as new, 8 weeks old, PSU £85. no offers. Tel: Crawley 512043.

ZX80. . . with 16k RAM pack, Sinc built with all leads, adaptor and manual, in perfect working order, £100. Tel: Abson (027 582) 2380 (w/ends only)

ZX80. . . standard 1k, Inverse video switch, all lead to connect to your TV and cassette recorder, instruction manual, all in original box, 6 months old (no mains adaptor) only £50. Tel: Wellington (Somerset) 2095.

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Anadex DP8000. . . printer, 96 ASCII set, 84 lines per minute RS232 int, £290 plus carriage. Tel: Bradford (0274) 875503 or 872546.

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Acorn System One. . . Inc additional RAM/IO device, PSU and 'Programming the 6502' by Rodney Zaks. Contact D Elworthy, 3 Carrwood Road, Wilmslow, Cheshire; or at St Catherine's College, Cambridge during term time. Price: £55.

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PCW. . . Vol 1 nos 4&5; Computing Today March, June, Dec 80, Feb 81; Practical Vol 1 nos 1,3, Vol 3 nos 11,12, vol 4 no 1. Tel Peter O'Rourke, 051 486 6837 eves.

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Casio FX502P. . . £65. Tel 01-949 0120 after 6, ask for Mike.

ZX80. . . Sinc built, inc adaptor and leads, etc, 'Making the most of your ZX80' Tim Hartnell also included. Excellent working order. Reason for selling is upgrading 2 months old. Inc Sinc manual, £65 p+P. Tel: 01-508 6200 (Loughton — Essex) eve only.

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NETWORK NEWS

Personal computer networks have been springing up all over the States for 18 months or more and now we have two in Britain. As more networks appear — and as more facilities are added to existing networks — we'll report them in this section, which appears monthly.

Forum 80. . . operated by Frederick Brown, tel: Hull (0482) 859169. No access charge, open to any micro owner. Operating Tues & Thurs 1900 — 2200, Sat & Sun 1200 — 2200. Facilities: bulletin board, program library for downloading programs (all in Microsoft Basic), program uploading for adding your own progs to library; Forum 80 Users Group (membership free) enables access to programs not in public domain.

National TRS-80 Users' Group. . . being set up at time of writing, will be available to all micro users, not just TRS-80 owners. Initially access charge will be a £10 sub, but as more join, this will be reduced and refunds made accordingly. Facilities: bulletin board & programs for downloading. Contact: Brian Pain, tel 0908 566660 (office).

USER GROUPS INDEX

These are updates/new entries received since our last full listing. The next complete list will be printed in our August issue.

INTERNATIONAL

KAOS — the official 6502 users' group of Australia. Has a range of projects within special interest groups: hardware, software, amateur radio, Pascal, education. Publishes monthly newsletter. Contact: Mr Ian Eyles, 10 Forbes St, Essondon, Victoria, Australia 3040

NATIONAL

TRS-80 Level 1 User Group. For Model I and Model III owners using Level 1 Basic. Produces bi-monthly newsletter, runs software library. Annual sub: £5. Contact (with SAE): N Rushton, 123 Roughwood Drive, Northwood, Kirkby, Merseyside L33 9UG.

Educational Users' Group for TRS-80 & Video Genie. Offshoot of Nat TRS-80 UG, other TRS-80/Vid Genie users welcome. Contact: D J Fatcher, Head Teacher, Beaconsfield First & Middle School, Beaconsfield Rd, Southall, Middx.

DEVON

Plymouth and District Amateur Computing Club. Meets each Wednesday, 7 — 9pm at King Street Methodist Church, Plymouth. Contact: Stuart Bell, 31 Victoria Place, Plymouth, Devon. PL2 1BY.

LANCASHIRE

N Lancs User Group. Covers Blackpool, the Fylde & Preston, meets monthly. Contact: John Robinson, 12 Harold Avenue, Blackpool or Julian Morgan on Blackpool 47514.

MERSEYSIDE

Merseyside TRS-80/Video Genie Users' Group. Contact: Peter Tootill, 101 Swanside Rd, Liverpool L14 7NL, tel 051-220 9733.

SUFFOLK

Suffolk Microcomputer Club. Meets monthly, produces newsletter, sub £5 pa. Contact: Mr S Pratt, c/o Microtek, 15 Lower Brook St, Ipswich, Suffolk IP4 1AQ, tel 0473 50152.

New ComputerTowns:
New Addington: Brigitte Gorton, 18 Pirbright Crescent, New Addington, Croydon CR0 0RT.

Caversham: Pat Colley, 52 Queensway, Caversham Park Village, Reading, Berks RG4 0SJ.

Gloucester: Steve Haynes, 5 Guinea Street, Kingsholm, Gloucester GL1 3BL.

DIARY DATA

London,	(West Centre Hotel) International Commodore PET Show. Contact: Baroness International on 01-734 2907	18 — 20 June
London	(Wembley Conf Centre) Int Word Processing Exbn & Conf. Contact: Business Equipment Trade Assoc, 01-405-6233	23 — 26 June
Sydney, Australia	Consumer Electronics Show. Contact: Riddell Exbn Promotions, 166 Albert Rd, S. Melbourne 3205	13 — 19 July
London	(Wembley Conf Centre) Microcomputer Show. Contact: Online, 09274 28211	13 — 19 July
London	(Cunard Int Hotel) Computer Software Exbn — SOFT. Contact: Executive Conf Organisers, 01-748 0287	2 — 4 Sept
Paris, France	Int Conf & Exbn Microprocessing and Microprogramming — Euromicro. Contact: Euromicro, 18 Rue Planchat, 75020 Paris	8 — 10 Sept
London	(Cunard Int Hotel) Personal Computer World Show. Contact: Montbuild, 01-486 1951	10 — 12 Sept
Anaheim, USA	Electronic Show & Convention — Wescon. Contact Network, 028 02 5226	14 — 16 Sept

PCW SUBSET

Alan Tootill presents more useful assembler — language subroutines. If you'd like to contribute your routines (for any of the popular processors), send them to: Sub Set, PCW, 14 Rathbone Place, LondonW1P 1DE.

Before we get immersed in any code, it should be said that we have been taken to task for printing, in Class 1, routines that alter registers that could be returned unaltered. Other readers think that, in order to make the use of multiple/conditional RETurns easier and economical, general purpose routines should not be obliged to save all registers possible, provided what they do is declared. Some processors have so few registers that they are not expected to carry values beyond the immediate processing task anyway.

The standard for Sub Set is that Class 1 routines are re-entrant, position-independent, not self-modifying and return unaltered all registers and flags, except those declared as being used to pass information to and from the routine. So we are aiming to keep to this in future. Routines that are not Class 1 for any good reason can be just as interesting and will still be printed.

In February's issue we posed the problem of PSHEM, which saved registers and carried forward unchanged the values of all the registers except HL, which was used to carry PSHEM's return address to the bottom of the stack thus:

```
PSHEM:  EX      (SP),HL ;HL to stack
        PUSH    DE
        PUSH    BC
        PUSH    AF
        PUSH    IX
        PUSH    IY
        PUSH    HL      ;return addr
                        ;to stack
        RET
```

After some further processing, the original values of all registers, including HL, could then be returned:

```
POPEM:  POP     HL      ;return addr
                        ;to HL
        POP     IY
        POP     IX
        POP     AF
        POP     BC
        POP     DE
        EX      (SP),HL
        RET
```

The problem was to carry HL also unchanged from PSHEM into the further processing. Though several readers noticed it in FOWIA, only Mark Restorick, a postgraduate of Salford University, pointed out that the last two instructions of PSHEM, PUSH HL and RET, could be replaced with JP (HL).

Both Tom Napier of Livingston and David Chambers of Aberdeen gave this ingenious way of combining PSHEM and POPEM in an 8080 equivalent version, requiring only one CALL to both save and restore registers, found in the Compucolor 11:

```
ISAVE:  XTHL            E3
        PUSH    D       D5
        PUSH    B       C5
        PUSH    PSW     F5
        CALL    JMPHL   CD YY YY
        POP     PSW     F1
        POP     B       C1
        POP     D       D1
        POP     H       E1
        RET             C9
JMPHL:  PCHL            E9
```

To borrow from the superb documentation of another similarly structured routine sent by Barry Philcox of Leafield near Oxford, it is used like this:

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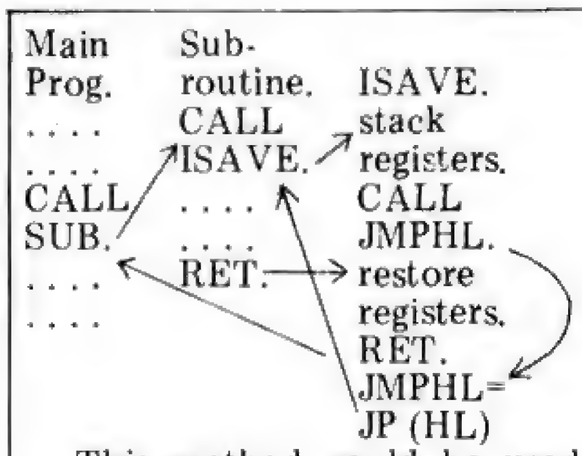
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This method could be used on the Z80 and expanded to save the IX and IY registers. But, since the registers are automatically restored after the processing between the PCHL (JP (HL)) and POP PSW (POP AF) instructions, it cannot be used where the registers are needed to pass information from the subroutine to the main program. Neither does it solve the PSHEM problem, since there is no way the original value of HL can be carried forward on a PCHL (JP (HL)) instruction.

The same solution, given in Datasheet PUSHM, was sent by Mark Restorick and Dave (arithmetic) Barrow. This doubles the length of the original PSHEM but a routine that carries forward every register unchanged does save us from having to remember which one is altered. Paul Bloomfield of Bryanston School, Blandford and Richard Steedman of Edinburgh sent correct solutions on the same lines but two bytes longer in restoring the original value into HL from the stack.

Datasheet

```
;= PUSHM — Save all registers.
;/ CLASS: 1
;/ TIME CRITICAL ? No
;/ DESCRIPTION: Pushes all regs, keeping their values unchanged
;/              and above the return address on the stack.
;/ ACTION:  (SP) ↔ HL
;/          STACK ← other registers; HL; AF
;/          Point HL at stack-saved H
;/          A ← (HL); L ← (HL-1); H←A
;/          AF ← STACK
;/ SUBr DEPENDENCE: None
;/ INTERFACES: None
;/ INPUT: None
;/ OUTPUT: All registers on stack
;/ REGs USED: None
;/ STACK USE: 14
;/ LENGTH: 20
;/ TIME STATES: 169
;/ PROCESSOR: Z80
PUSHM:  EX    (SP),HL   ; get return address in HL      E3
        PUSH  DE        ; and put HL and                D5
        PUSH  BC        ; all other                     C5
        PUSH  AF        ; registers                     F5
        PUSH  IX        ; and flags                     DD  E5
        PUSH  IY        ; on stack.                     FD  E5
        PUSH  HL        ; return address to stack head. E5
        PUSH  AF        ; save AF for local use.        F5
        LD H  HL,+15    ; point HL at H                 21  0F  00
        ADD   HL,SP     ; on stack and                  39
        LD    A,(HL)    ; get in A.                     7E
        DEC   HL        ; point at L on stack           2B
        LD    L,(HL)    ; restore to L.                 6E
        LD    H,A       ; restore H                     67
        POP   AF        ; and AF.                       F1
        RET             ; return.                       C9
```

Shorter and faster, at 15 bytes and 121 t-states, but using the alternate register set we originally decided to keep for the fast interrupt service and also changing H'L', is this code sent in by both Gordon Grant of Manchester and Neil Imrie of Bedford:

```
EXX          D9
POP   HL     E1
EXX          D9
PUSH  DE     D5
PUSH  BC     C5
PUSH  AF     F5
PUSH  HL     E5
PUSH  IX     DD  E5
PUSH  IY     FD  E5
EXX          D9
PUSH  HL     E5
```


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```
EXX             D9
RET             C9
```

Other solutions depended on receiving a small area of RAM as a temporary store for one or more registers. While this can be effective in private single-user environments it is not so useful for general purpose routines to be used in many different systems. One such solution from Barry Philcox, to be used like ISAVE, is given in Listing 1

```
SVALL:  LD      (TMPHL),HL      ; save HL in RAM.       22  YY  YY
        LD      (TMPDE),DE      ; save DE in RAM.       ED  53  YY  YY
        EX      (SP),HL         ; swap HL and return addr. E3
        PUSH    DE              ; save DE on stack.     D5
        PUSH    BC              ; save BC on stack.     C5
        PUSH    AF              ; save AF on stack.     F5
        LD      DE,RESTR        ; put co-routine        11  YY  YY
        PUSH    DE              ; address on stack.     D5
        PUSH    HL              ; put return addr on stack. E5
        LD      HL,(TMPHL)      ; restore HL.           2A  YY  YY
        LD      DE,(TMPDE)      ; restore DE.           ED  5B  YY  YY
        RET                     ; to calling subroutine. C9
RESTR:  POP     AF              ; restore AF.           F1
        POP     BC              ; restore BC.           C1
        POP     DE              ; restore DE.           D1
        POP     HL              ; restore HL.           E1
        RET                     ; to main program.      C9
TMPHL:  DEFW                    ; two bytes for HL.
TMPDE:  DEFW                    ; two bytes for DE.
```

Listing 1

Does this point the way to a single-call save and restore routine like ISAVE, which will carry HL forward unchanged after the registers are saved but, as in our revised PSHM, will use the stack instead of its own revised area of RAM?

Random numbers

First some improvements to April's RNDCH from Dave Barrow. Replace JP P,LOOP 3 by JR NC,LOOP3, saving one byte. Better still, the following code saves three further program bytes and two stack bytes at the expense of up to 280 or so t-states:-

```
RNDCHS: PUSH    HL          ; table addr.
        LD      A,R         ; random no.
LOOP:   SUB     (HL)        ; table length.
        JR      NC,LOOP     ; get
        ADC     A,(HL)      ; displacement
        ADD     A,L         ; and add
        LD      L,A         ; into
        JR      NC,SKIP     ; table
        INC     H           ; address.
SKIP:   LD      A,(HL)      ; get chr.
        POP     HL
        RET
```

While adequate in the context in which it was used (selecting a character after pressing the key of the previous randomly selected character) the routine is not as random as it might be. If the same key is used all the time to trigger the selection of a character, some keys (on the Nascom 1 anyway) result in either all odd or all even table addresses being generated, while other keys give alternate odd and even addresses.

Next, in Datasheet RAND, is a 16-bit pseudo random number generator from Gerald Evans of Merthyr Tydfil. It uses the formula Xi+1 = aXi + C mod M where:

M = 2**16

C may be any odd number (RAND uses 41)

a = 1 mod 4 (1,5,9,13 etc.)

Some a's are better than others; 765, 889, 989 and 2009 being some good values. RAND uses 257, which is reasonably good and easy to multiply by. The sequence of random numbers will repeat after 65,536 numbers have been generated. Note that HL should contain the previous random number. It must therefore be seeded (the R register can be used) before the first call and saved between subsequent calls to RAND.

Datasheet

```
;= RAND — 16-bit pseudo random number generator
;/ CLASS: 1
;/ TIME CRITICAL: No
;/ DESCRIPTION: Generates a 16-bit random number from the series
                    Ri+1 = Ri*257 + 41 mod 2**16
;/ ACTION: Save AF, BC
;/         Save HL
;/         HL ← HL * 256 ignoring carries
;/         HL ← HL + value off stack ignoring carry
```


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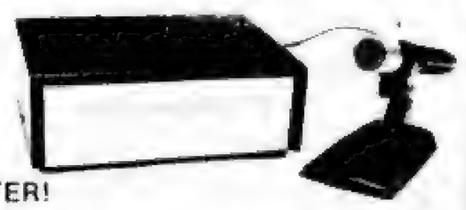
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```
;/              HL ← HL + 41 ignoring carry
;/              Restore BC, AF
;/ SUBr DEPENDENCE: None
;/ INTERFACES:  None
;/ INPUT:       HL contains the previous random number or,
;/              at the first call, a seeded number
;/ OUTPUT:      HL contains the new random number which
;/              must be saved for the next call
;/ REG's USED:  HL
;/ STACK USE:   6
;/ LENGTH:      20
;/ TIME STATES: 223
;/ PROCESSOR:   Z80, 8080/85

RAND:  PUSH  AF     ; save registers          F5
       PUSH  BC     ; and flags.              C5
       PUSH  HL     ; stack random number.    E5
       ADD   HL,HL  ; *2                      29
       ADD   HL,HL  ; *4                      29
       ADD   HL,HL  ; *8                      29
       ADD   HL,HL  ; *16                     29
       ADD   HL,HL  ; *32                     29
       ADD   HL,HL  ; *64                     29
       ADD   HL,HL  ; *128                    29
       ADD   HL,HL  ; *256                    29
       POP   BC     ; old random number.      C1
       ADD   HL,BC  ; *257                    09
       LD    BC,+41;                          01  29  00
       ADD   HL,BC  ; *257+41                 09
       POP   BC     ; restore                 C1
       POP   AF     ; registers and flags.    F1
       RET                                    C9
```

LEISURE LINES

by J J Clessa

April's puzzle was very easy — we had about 200 replies, all of them correct! Several readers, hoping to increase their chances of being randomly selected, sent in multiple entries; these were detected, however, and the excess ones duly binned.

Anyway, the chosen winner was Mr A R Ashton from Knaresborough, N Yorks, who'll receive this month's prize of an exciting book token. The winning solution is 62, obtained as follows: A6, A7, B1, D2, F6, F7, G4, H1 (labelling the rows A-H and the columns 1-8).

Quickie

As usual, no prizes, so no answers required. Rearrange the following letters to form one word: NEW DOOR.

Prize puzzle

Another one to bust your micros, if there are any left after last month's puzzle.

1) Find the largest prime number which, when its digits are translated into characters, gives an English word.

2) Translate as follows:

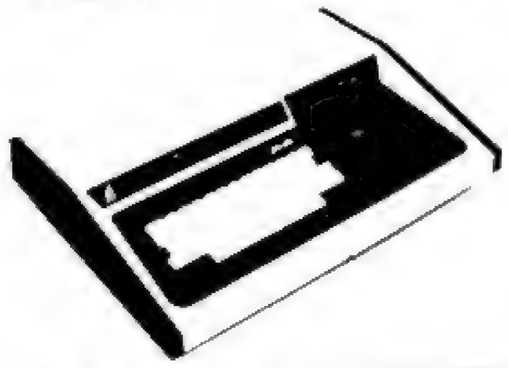
0 = R	5 = N
1 = D	6 = I
2 = A	7 = S
3 = G	8 = T
4 = B	9 = E

3) The word must be an entry, or the derivative of an entry, in the *Concise Oxford Dictionary*, Fifth Edition (not the appendices); no foreign words or proper nouns are permitted.

Send your answer on a *postcard*, including both the number and the word, to Puzzle 23, *PCW*, 14 Rathbone Place, London W1P 1DE, to arrive no later than 31 August. This month's prize will be a copy of the aforementioned dictionary!

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ZX80 Sliding letters

by B Cope

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Enter this program and press RUN. There are three degrees of difficulty — so try the easy one first. A randomly generated board will be displayed with one blank tile.

Type in the letter that you wish to slide into the blank position. Illegal requests will be ignored. A correct board with the blank in the lower right corner will be acknowledged, and another turn offered.

If you give up during the game, enter 99. The program runs in 1k.

```
 10 RANDOMISE
 20 DIM A(35)
 30 FOR B = 0 TO 35
 40 LET A(B) = — 1
 50  NEXT B
 60  FOR B = 1 TO 4
 70  FOR C = 1 TO 4
 80 LET A(6*B+C) = 33+4*B+C
 90 NEXT C
100 NEXT B
110 LET B = 28
120 LET A(B) = 0
130 PRINT "1=EASY 2=NORMAL 3=HARD"
140 INPUT F
150 LET F = 200 + 150*(F=2) + 180*(F=1)
160 LET C = 0
170 LET D = RND(4)
180 LET E = (D=1)—(D=2)+6*(D=3)—6*(D=4)
190 IF A(B + E) < 0 THEN GO TO 170
200 LET A(B) = A(B + E)
210 LET A(B + E) = 0
220 LET C = C +1
230 IF C = F THEN GO TO 410
240 LET B = B + E
250 GO TO 170
260 CLS
270 PRINT "MOVE";E
280 LET D = 0
290 FOR B = 1 TO 4
300 PRINT
310 FOR C = 1 TO 4
320 PRINT CHR$(A(6*B + C));"*"
330 IF A(6*B+C)=33+4*B+C THEN LET D=D+1
340 NEXT C
350 PRINT
360 PRINT
370 NEXT B
380 IF D = 15 AND A(28) = 0 THEN GO TO 550
390 PRINT "LETTER PLEASE?"
400 RETURN
410 LET E = 0
420 GOSUB 260
430 INPUT A$
440 IF A$ = "99" THEN STOP
450 FOR B = 7 TO 28
460 IF A(B) = CODE (A$) THEN LET C = B
470 IF A(B) = 0 THEN LET D = B
480 NEXT B
```


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```
490 LET B = C — D
500 IF NOT(ABS(B)=1 OR ABS(B)=6) THEN GO TO 430
510 LET A(D) = A(C)
520 LET A(C) = 0
530 LET E = E + 1
540 GOTO 420
550 PRINT "WELL DONE"
560 RUN
```

UK101 Car Rally

by Martin Stiby

Steer the car through the well littered race track.

```
40 Q9=INT(RND(1)*100+100)
49 FORT=1TO16:PRINT:NEXT
50 GOSUB3000
65 POKE54221,32:S=64:D=53565:M=53536:Z3=53340
80 N=53984:F=18:U=53728:POKEU,18
90 POKE11,34:POKE12,2:POKE530,1:K=57088:POKEK,127
95 P1=127:P2=191:P3=32:P4=179:P5=1:P6=.5:P7=8:P8=40
99 REM movement routines
100 P=PEEK(K)
110 IFP=P1ANDU)MTHENPOKEU,P3:U=U-S
120 IFP=P2ANDU(NTHENPOKEU,P3:U=U+S
130 IFPEEK(U)=P4THENGOSUB1000
200 X=USR(X):POKEU-P5,P3
205 IFPEEK(U)=P4THENGOSUB1000
220 POKEU,F
300 IFRND(P5)(P6GOTO600
400 I=S*INT(RND(P5)*P7)
410 POKED+I,P4
600 Q=Q+P5:Z=Z+P5
620 IFQ)Q9THENZ=Z+P5:GOTO100
640 FORT=P5TOP8:NEXT
998 GOTO100
999 REM crash routines & score
1000 H=H+1:O=0
1005 POKEU-P5,P3
1020 FORT=1TO10
1030 FORT1=16TO23
1040 POKEU,T1
1050 FORT2=1TO10
1060 NEXTT2,T1,T
1070 POKEU,18
1075 IFH=5THEN2000
1080 POKEZ3-1,83:POKEZ3-2,73
1090 POKEZ3-4,69:POKEZ3-5,82:POKEZ3-6,79
1095 POKEZ3-7,67:POKEZ3-8,83
1100 Z$=STR$(Z):Z1=LEN(Z$)
1120 FORZ2=Z3TOZ3+Z1-P5:Z4=Z4+P5
1140 POKEZ2,ASC(MID$(Z$,Z4,P5)):NEXT:Z4=0
1170 FORT=1TO5000:NEXT
1180 Q9=INT(RND(1)*100+100)
1200 FORZ2=Z3-P7TOZ3+Z1-P5:POKEZ2,P3:NEXT
1300 FORT=1TO3000:NEXT
1998 RETURN
1999 REM final score & end
2000 FORT=1TO16:PRINT:NEXT
```


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```
2010 POKE530,0:POKE518,255
2020 PRINT"  YOUR FINAL SCORE IS";Z
2030 PRINT:PRINT:PRINT
2040 PRINT"Do you want another go";
2045 POKE518,0:INPUTA$
2050 FORT=1TOLEN(A$):IFMID$(A$,T,1)="Y"THENRUN
2060 NEXT
2070 FORT=1TO16:PRINT:NEXT
2090 END
2999 REM code for car movement & instructions
3000 DATA 162,1,189,0,210,157,255,209,169,32
3010 DATA 157,0,210,189,0,209,157,255,208,169
3020 DATA 32,157,0,209,232,208,231,169,32,141
3030 DATA 12,209,141,76,209,141,140,209,141
3040 DATA 204,209,141,12,210,141,76,210,141
3050 DATA 140,210,141,204,210,96
3100 FORT=546TO599:READT1:POKET,T1:NEXT
3200 INPUT"Do you need instructions ";A$
3210 FORT=1TOLEN(A$):IFMID$(A$,T,1)="Y"THEN3300
3220 NEXT
3230 GOTO3600
3300 PRINTTAB(15) CAR RALLY"
3310 PRINT
3320 PRINT"  You have to work your way through the cars"
3330 PRINT"you are over-taking, without hitting them."
3340 PRINT"After the 5th time you crash the game
          will end"
3355 PRINT
3360 PRINTAB(13)"CONTROLS ARE :"
3370 PRINT"     £ 1     Move up"
3380 PRINT"     £ 2     Move down"
3390 PRINT
3400 PRINT"  W A R N I N G  ! ! ! !......."
3410 PRINT" Your car will accelerate some time during"
3420 PRINT"each part of the race.....so watch out !"
3440 PRINT
3500 POKE11,0:POKE12,253
3510 PRINT"Get your crash helmet on and press any key."
3520 X=USR(X)
3600 PRINT:PRINT:PRINT:PRINT:PRINT:PRINT
3610 PRINT" -       -       -       -       -
3620 PRINT:PRINT:PRINT:PRINT:PRINT:PRINT:PRINT:PRINT
3630 PRINT" -       -       -       -       -
3640 PRINT:PRINT
3998 RETURN
```

TRS-80 Calendar

by J E Barker

This program provides calendar details for any year from 1753 to 4902. It says 1582 onwards in the listing but that does not apply to Britain.

```
10 'CALENDAR:- BY J.E.BARKER
11 'FOR TRS-80 LEVEL II
12 '1 JANUARY 1981
30 CLEAR1000:DEFINTA-Z:DIMD$(12),M(12):FORI=1TO12:READD$(I):NEXTI
40 PRINT"****** C A L E N D A R ******"
50 PRINT:PRINT"THIS PROGRAMME WILL DISPLAY
60 PRINT"A CALENDAR FOR ANY YEAR
70 PRINT"FROM 1582 (G.B.NOT INC.
80 PRINT
90 INPUT"TYPE IN YEAR REQUIRED.          THEN PRESS ENTER.";Y
100 IF Y<1 OR INT(Y)<>Y OR Y>1582 OR Y>4902 THEN PRINT:PRINT"Y=";Y"IS OUT OF RANGE": FO
R X=1 TO 1000: NEXT: GOTO 90
110 PRINT:PRINT"TO SEE A PART COLOUR MONITOR ENTER
```


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PROGRAMS

```
120 PRINT"MONTH NUMBER.  (I.E. 1 TO 12)
130 PRINT"OTHERWISE PRESS ENTER FOR THE  COMPLETE YEAR.";
140 INPUT K: IF K=0 THEN 160
150 IF K () INT (K) OR K)12  THEN CLS:PRINT CHR$(23): PRINT:PRINT"WHAT? ---"K;"M
ONTHS IN A YEAR,":PRINT"           MAKE UP." :GOTO 140
160 CLS
170 '*** FIND DAY OF WEEK OF JAUARY 1ST ***
180 Y1=INT((Y-1)/100)
190 Y2=Y-1-100 * Y1
200 Y3=Y
210 '*** THIS IS ZELLERS CONGRUANCE ***
220 D=799+Y2+INT(Y2/4)+INT(Y1/4)-2*Y1
230 D=-(D-(INT(D/7)*7))
240 L=0
250 '*** CHECK FOR LEAP YEAR ***
260 IF((INT(Y/4)*4) () Y) THEN 360
270 IF((INT(Y/400)*400)=Y) THEN 290
280 IF((INT(Y/100)*100)=Y) THEN 360
290 L=1
300 PRINTCHR$(23)
310 FOR T=1 TO 50
320 IF L=1 AND Y(1981 THEN PRINT@448,Y;"WAS A LEAP YEAR."
330 IF L=1 AND Y)1981 THEN PRINT@448,Y;"WILL BE A LEAP YEAR."
350 NEXT T: CLS
360 FOR N=1 TO 12:PRINT:PRINT
370 READ A$,M
380 DATA "* JANUARY *",31,"* FEBRUARY *",28,"** MARCH **",31
390 DATA "** APRIL **",30,"*** MAY ***",31,"*** JUNE ***",30
400 DATA "*** JULY ***",31,"* AUGUST **",31," SEPTEMBER ",30
410 DATA "* OCTOBER *",31,"* NOVEMBER *",30,"* DECEMBER *",
420 IF K=0 THEN 440
430 IF N ( K THEN 470
440 CLS:PRINTTAB(4)S$;A$;S$;
450 PRINT"          SUN      MON      TUE      WED      THU      FRI      SAT"
460 PRINTTAB(4)S$;"---";Y;"---";S$
470 IF N () 2 THEN 490
480 M=M+L
490 FOR I=1 TO 6:PRINT
500 FOR J=1 TO 7
510 D=D+1
520 IF D ) M THEN 610
530 IF D (= 0 THEN 570
540 IF K ) 0 AND K=N=1 THEN PRINT@270,"ALMOST THERE";
550 IF N ( K THEN PRINTCHR$(23):PRINT@200,"A FEW MOMENTS PLEASE !";:GOTO 570
560 PRINTTAB(J*8)D;
570 NEXT J
580 J=1
590 IF D=M THEN 610
600 NEXT I
610 D=1-J
620 IF N=12 AND K=0 THEN 710
630 IF K=0 THEN 660
640 IF N( K THEN NEXT N
650 IF N=12 OR N=K THEN 710
660 PRINT:PRINT:PRINT:PRINT:PRINT"PRESS -- N -- FOR NEXT MONTH, OR -- E -- TO CA
NCEL.";
670 Z$=INKEY$:IF Z$="C" THEN 740ELSE 680
680 IF Z$="N" THEN 630ELSE 670
690 CLS: K=0
700 NEXT N
710 K=0:PRINT:PRINT:PRINT:PRINT:PRINT"FOR ANOTHER YEAR PRESS ENTER. FOR ANOTHER
MONTH IN";Y3
720 INPUT"ENTER MONTH NUMBER (I.E. 1 TO 12)";N
730 IF K=0 THEN 740 ELSE RESTORE:CLS:GOTO 150
740 RESTORE: GOTO 30
```

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by J G Patton

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```
5 REM MACHINE LANGUAGE TO BASIC LOADER TAPE CONVERSION PROGRAM
7 REM FOR OSI SUPERBOARD II
10 REM WRITTEN BY EAMONN J.G. PATTON -JAN '81
20 REM SL=CURRENT LINE NO.
25 REM SA=START ADDRESS OF MACHINE CODE PROGRAM
30 REM EA=END ADDRESS OF SAME
```


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PROGRAMS

```
35 REM ARRAY A$ CONTAINS BASIC KEY WORDS
40 REM V=FLAG IF VECTOR TO BE SET(-1=TRUE)
45 REM T=LOOP VARIABLE
50 REM A$=GENERAL INPUT STRING VARIABLE
55 REM Q$=TEMP. STRING VARIABLE
60 REMV1-V4&V6 USED AS TEMP VARIABLES IN HEX-DEC CONVERSION
65 REM VH CONTAINS HIGH BYTE OF VECTOR
70 REM VL CONTAINS LOW BYTE OF VECTOR
75 REM VB CONTAINS ADDRESS OF VECTOR LOW BYTE
80 REM LINES 100-160 INPUT DATA ABOUT M/C PROG
81 REM LINES 170-180 SET UP ARRAY WITH KEYWORDS
82 REM LINES 190-360 SAVE ON TAPE
83 REM LINES 5000-5005 INCREMENT LINE NO. AND CHECK NOT TOO HIGH
84 REM LINES 10000-10130 GET VECTOR & SPLIT TO HIGH&LOW BYTE
85 REM LINES20000-20020 ERROR ROUTINE IF LINE NO. TOO HIGH(BIG PROG!)
100 INPUT"START ADDRES";SA:REMSTART ADDRES
105 SA=INT(SA)
110 IFSA<00RSA)2^16THEN100
120 INPUT"END ADDRESS";EA
125 EA=INT(EA)
130 IFEA<00REA(=SAOREA)2^16THEN100
140 INPUT"IS THERE A VECTOR TO SET";A$
150 IFLEFT$(A$,1)="Y"THENGOSUB10000:V=-1:REMGETVECTORVFLAG=-1IFTRUE
160 INPUT"STARTLINE NO.";SL:IFSL)63000RSL<00RSL()INT(SL)THEN160
161 REM HIGHEST LINE NO. IN BASIC IS 63999
170 DIMA$(7):FORT=0TO7:READA$(T):NEXT
171 REM READ IN 'PROGRAM STATEMENTS'
180 DATA"DATA",",","FORX=","TO","READA","POKEX,A","NEXT","POKE"
190 POKE11,0:POKE12,253 :PRINT"PRESS PLAY AND RECORD AND HIT A";
191 POKE15,255:PRINT" KEY WHEN READY":X=USR(X)
195 REM JUMP TO MONITOR SUBROUTINE WHICH WAITS UNTIL KEY PRESSED
199 PRINT:PRINT:PRINT
200 SAVE:POKE15,72:REM SET THE SAVE MODE AND TERMINAL WIDTH
201 PRINTCHR$(64):PRINT:REM CLEAR NOISE CHARACTERS
205 GOSUB5000:REMNEWLINENO.
210 FORT=SATOEA
220 V1=PEEK(T)
230 PRINTV1;
240 IFPEEK(14))65ANDT<EATHENPRINT:GOSUB5000:GOTO250
241 REM NEAR END OF LINE
244 IFT)=EATHEN250
245 PRINTA$(1);
250 NEXTT
270 PRINT
280 SL=SL+10:IFSL)63999THEN20000
290 PRINTSL;A$(2);SA;A$(3);EA
295 SL=SL+10:IFSL)63999THEN20000
300 PRINT::PRINTSL;A$(4);":";A$(5)
305 SL=SL+10:IFSL)63999THEN20000
310 PRINT:PRINTSL;A$(6)
320 IFVTHEN340
330 POKE517,0:END
340 SL=SL+10:IFSL)63999THEN20000
350 PRINTSL;A$(7);VB;A$(1);VL;":";A$(7);VB+1;A$(1);VH
360 POKE517,0:END
5000 PRINTSL;A$(0);:SL=SL+10:IFSL)63999THEN20000
5005 RETURN
10000 INPUT"VECTOR-IN HEX";A$
10004 REM ERROR CHECK
10005 IFLEN(A$)<>4THEN10000
10007 FORV6=1TO4:Q$=MID$(A$,V6,1)
10008 IF(Q$)="0"ANDQ$(="9")OR(Q$)="A"ANDQ$(="F")THEN10010
10009 GOTO10000
10010 NEXTV6
10015 IFLEFT$(A$,1))"9"THENV1=9+ASC(LEFT$(A$,1))-64:GOTO10030
10020 V1=VAL(LEFT$(A$,1))
10030 IFMID$(A$,2,1))"9"THENV2=9+ASC(MID$(A$,2,1))-64:GOTO10050
10040 V2=VAL(MID$(A$,2,1))
10050 VH=16*V1+V2
10060 IFMID$(A$,3,1))"9"THENV3=9+ASC(MID$(A$,3,1))-64:GOTO10080
10070 V3=VAL(MID$(A$,3,1))
10080 IFMID$(A$,4,1))"9"THENV4=9+ASC(MID$(A$,4,1))-64:GOTO10100
10090 V4=VAL(MID$(A$,4,1))
10100 VL=16*V3+V4
10110 INPUT"ADDRESS OF VECTOR LOW BYTE IN DEC.";VB
10120 IFVB<00RVB)2^160RVB<>INT(VB)THEN10110
10130 RETURN
```


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PROGRAMS

```
19999 REM TOO HIGH LINE NO. ROUTINE
20000 POKE517,0:REM SAVE OFF
20010 PRINT"ERROR!-LINE NOS. TOO HIGH.PICK A LOWER LINE NO NEXT TIME"
20020 FORT=1TO2000:NEXT:RUN
```

Sample run

```
50006 DATA 152 , 72 , 172 , 249 , 2 , 173 , 248 , 2 , 145 , 249 , 136
50016 DATA 206 , 249 , 2 , 32 , 244 , 31 , 104 , 168 , 169 , 0 , 96
50026 DATA 76 , 185 , 30 , 152 , 72 , 32 , 214 , 31 , 172 , 249 , 2
50036 DATA 169 , 35 , 145 , 249 , 238 , 249 , 2 , 208 , 2 , 230 , 250
50046 DATA 200 , 32 , 244 , 31 , 104 , 168 , 169 , 0 , 96 , 202 , 16
50056 DATA 4 , 232 , 76 , 153 , 163 , 138 , 72 , 152 , 72 , 172 , 249
50066 DATA 2 , 174 , 0 , 2 , 173 , 250 , 2 , 240 , 5 , 173 , 248
50076 DATA 2 , 145 , 249 , 169 , 32 , 157 , 0 , 211 , 202 , 136 , 206
50086 DATA 249 , 2 , 206 , 0 , 2 , 169 , 95 , 157 , 0 , 211 , 206
50096 DATA 246 , 2 , 173 , 250 , 2 , 240 , 3 , 32 , 244 , 31 , 104
50106 DATA 168 , 104 , 170 , 169 , 0 , 96 , 32 , 186 , 255 , 201
50116 DATA 21 , 240 , 26 , 201 , 95 , 240 , 182 , 201 , 4 , 240 , 150
50126 DATA 201 , 2 , 240 , 143 , 201 , 6 , 240 , 111 , 201 , 13 , 240
50136 DATA 80 , 32 , 214 , 31 , 76 , 153 , 163 , 56 , 152 , 72 , 173
50146 DATA 250 , 2 , 240 , 8 , 172 , 249 , 2 , 173 , 248 , 2 , 145
50156 DATA 249 , 238 , 250 , 2 , 173 , 250 , 2 , 201 , 28 , 240 , 31
50166 DATA 201 , 1 , 208 , 6 , 173 , 0 , 2 , 141 , 249 , 2 , 173
50176 DATA 249 , 2 , 233 , 32 , 176 , 2 , 198 , 250 , 141 , 249 , 2
50186 DATA 168 , 32 , 244 , 31 , 104 , 168 , 169 , 0 , 96 , 169 , 0
50196 DATA 141 , 250 , 2 , 169 , 211 , 133 , 250 , 173 , 0 , 2 , 141
50206 DATA 249 , 2 , 208 , 230 , 169 , 0 , 141 , 250 , 2 , 133 , 249
50216 DATA 169 , 211 , 133 , 250 , 169 , 32 , 141 , 248 , 2 , 169
50226 DATA 101 , 141 , 246 , 2 , 141 , 249 , 2 , 169 , 13 , 96 , 152
50236 DATA 72 , 32 , 214 , 31 , 173 , 248 , 2 , 172 , 249 , 2 , 145
50246 DATA 249 , 141 , 247 , 2 , 200 , 238 , 249 , 2 , 208 , 2 , 230
50256 DATA 250 , 32 , 244 , 31 , 104 , 168 , 173 , 247 , 2 , 76 , 153
50266 DATA 163 , 72 , 173 , 0 , 2 , 205 , 246 , 2 , 16 , 13 , 56
50276 DATA 173 , 249 , 2 , 233 , 32 , 176 , 2 , 198 , 250 , 141 , 249
50286 DATA 2 , 173 , 0 , 2 , 141 , 246 , 2 , 104 , 96 , 177 , 249
50296 DATA 141 , 248 , 2 , 169 , 95 , 145 , 249 , 96
50316 FORX= 7865 TO 8169
50326 READA:POKEX,A
50336 NEXT
50346 POKE 536 , 45 :POKE 537 , 31
```

PET Examination questions

by Stephen Lucking

Just for once, here's a *useful* program — well, teachers should find it useful, anyway. It allows you to build up groups of multiple choice questions, random selections of which can then be printed out for examinations.

```
10 M=100 INPUT"□HILL YOU WILL BE DEALING WITH MORE THAN 100 QUESTIONS■■.■■■",A$
20 IFLEFT$(A$,1)="N"THEN40
30 INPUT"■ABOUT HOW MANY WILL YOU BE USING■■■+■■■",A M=A+100
40 DIMA$(M),B$(3,M),C$(M),A(M),A1$(M),B1$(3,M),C1$(M)
45 REM
50 REM********** MENU **********
55 REM
60 PRINT"□DO YOU WANT TO :-"
70 PRINT"■■1) MAKE A DATA TAPE"
80 PRINT"■2) LOAD A DATA TAPE"
90 PRINT"■3) ADD TO THE DATA TAPE IN MEMORY"
100 PRINT"■4) A PRINT OUT OF ALL THE QUESTIONS"
110 PRINT"■5) A LIST OF ALL THE QUESTIONS"
120 PRINT"■6) TO CHECK THE QUESTIONS"
125 PRINT"■7) SOME QUESTIONS PICKED RANDOMLY"
126 PRINT"■8) TO PICK YOUR OWN QUESTIONS"
127 PRINT"■9) TO RUN THE EXAM"
128 PRINT"■10) END"
129 POKE158,0
130 INPUT"■■■+■■■",O ONGOTO200,400,600,800,300,250,4100,5000,6000,170
140 GOTO50
150 PRINT"□" END
199 REM
200 REM ****** MAKE A DATA TAPE *****
201 REM
202 F=1
```


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PROGRAMS

```
210 INPUT"□HOW MANY QUESTIONS DO YOU WANT TO RECORD ■■■□■■■■";A
220 FORX=PTOA:PRINT"□QUESTION"X:INPUT"■■■?■■■■";A$(X)
230 FORY=1TO3:PRINT"■ANSWER "CHR$(Y+64)") ■■■□■■■■";:INPUTB$(Y,X):NEXT
240 INPUT"■CORRECT ANSWER = (A,B OR C) ■■■ ?■■■■";C$(X):NEXT
250 INPUT"□□DO YOU WANT TO CHECK THE QUESTIONS";A$:IFLEFT$(A$,1)="N"THEN300
260 FORX=1TOA:A(X)=0:NEXT
270 FORX=1TOA:PRINT"□QUESTION"X") = "A$(X)
280 FORY=1TO3:PRINT"■"CHR$(Y+64)") = "B$(Y,X):NEXT:PRINT"■ANSWER = "C$(X)
290 POKE158,0
299 PRINT"■O.K. ? "
300 GETA$:IFA$="Y"THEN320
310 IFA$<>"N"THEN300
315 A(X)=1
320 NEXT
330 FORX=1TOA:IFA(X)=0THEN370
340 PRINT"□QUESTION"X");"A$(X):INPUT"CHANGE TO ";A$(X)
350 FORY=1TO3:PRINT"■"CHR$(Y+64)");"B$(Y,X):INPUT"CHANGE TO ■■■(■■■■" B$(Y,X)
351 NEXT
360 INPUT"■ANSWER = ";C$(X)
370 NEXT
380 INPUT"■■DO YOU WANT TO RE-CHECK THEM ■■■?■■■■";A$:IFLEFT$(A$,1)="Y"THEN260
390 GOSUB3000:GOSUB1000:GOTO50
395 REM
400 REM ****** LOAD A DATA TAPE *****
405 REM
410 M=1:GOSUB3000:INPUT"■■WHAT IS THE NAME OF THE TAPE TO BE      LOADED";T$
420 OPEN1,1,0,T$
421 PRINT"■FOUND "T$:PRINT"■NOW LOADING QUESTIONS"
425 INPUT#1,A
430 FORX=MTOA:INPUT#1,A$(X):NEXT
440 FORX=MTOA:FORY=1TO3:INPUT#1,B$(Y,X):NEXT:NEXT
450 FORX=MTOA:INPUT#1,C$(X):NEXT:CLOSE1:GOTO50
460 REM
600 REM ****** ADD TO DATA TAPE *****
605 REM
610 IFA$(1)=""THENGOSUB2000:GOTO50
620 PRINT"□■■THE LAST QUESTION WAS NO. "A
630 INPUT"HOW MANY QUESTIONS DO YOU WANT TO ADD";Q
640 P=A+1:A=A+Q
650 GOTO220
660 REM
800 REM ********* PRINT OUT *********
801 REM
805 IFA$(1)=""THENGOSUB2000:GOTO50
810 OPEN4,4:FORX=1TOA:PRINT#4," QUESTION"X:PRINT#4,"──────────"
820 PRINT#4:PRINT#4,A$(X):FORY=1TO3:PRINT#4,CHR$(Y+64)") "B$(Y,X):NEXT:PRINT#4
830 NEXT:CLOSE4:GOTO50
850 REM
900 REM *********   LIST    *********
901 REM
905 IFA$(1)=""THENGOSUB2000:GOTO50
910 FORX=1TOA:PRINT"□QUESTION"X") "A$(X)
920 FORY=1TO3:PRINT"■"CHR$(Y+64)") "B$(Y,X):NEXT
930 PRINT"■ANSWER = "C$(X):PRINT"■■PRESS ANY KEY":POKE158,0
940 WAIT158,1:NEXT:GOTO50
950 REM
1000 REM ****************************
1010 REM ***** SAVE QUESTIONS ******
1020 REM ****************************
1021 REM
1025 INPUT"■■■WHAT DO YOU WANT TO CALL THE TAPE" T$
1030 OPEN1,1,1,T$:PRINT#1,A
1040 FORX=1TOA:PRINT#1,A$(X):NEXT
1050 FORX=1TOA:FORY=1TO3:PRINT#1,B$(Y,X):NEXT
1060 NEXT:FORX=1TOA:PRINT#1,C$(X):NEXT:CLOSE1
1070 RETURN
2000 PRINT"□I HAVE NO QUESTIONS IN MEMORY."
2010 PRINT"■■YOU MUST LOAD A DATA TAPE FIRST."
2020 FORS=1TO5000:NEXT:RETURN
3000 PRINT"□1) LOAD YOUR TAPE INTO THE CASSETTE"
3010 PRINT"■2) REWIND THE TAPE"
3020 PRINT"■3) PRESS STOP WHEN FULLY REWOUND" POKE158,0
3025 PRINT"■■PRESS [SPACE] WHEN READY"
3030 GETA$:IFA$<>" "THEN3030
3040 RETURN
4000 REM*** RANDOMLY PICKED QUESTIONS***
4010 INPUT"□HOW MANY QUESTIONS DO YOU WANT PICKED";Q
4020 IFQ>ATHENPRINT"■■THERE ARE ONLY"A" QUESTIONS":GOSUB4000:GOTO4010
4025 GOSUB4030:GOTO4050
4030 FORX=1TOA:A1$(X)=A$(X):A$(X)="":C1$(X)=C$(X):C$(X)="***"
4040 FORY=1TO3:B1$(Y,X)=B$(Y,X):B$(Y,X)="":NEXT:NEXT
4045 RETURN
4050 FORX=1TOA:A(X)=0:NEXT
4055 V=1
4060 FORX=1TOQ
4070 W=INT(A*RND(1)+1):IFA(W)=1THEN4070
4080 A$(V)=A1$(W):C$(V)=C1$(W):FORY=1TO3:B$(Y,V)=B1$(Y,W):NEXT:A(W)=1
4090 V=V+1:NEXT
4100 A=Q:GOTO50
4999 REM
5000 REM***     PICK OWN QUESTIONS     ***
```


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PROGRAMS

```
5001 REM
5005 FORX=1TOA:A$(X)=0:NEXT
5010 FORX=1TOA:PRINT"■QUESTION"X" ";A$(X)
5020 FORY=1TO3:PRINT"■"CHR$(Y+64)" ";B$(Y,X):NEXT
5030 PRINT"■■DO YOU WANT THIS ONE ";:POKE158,0
5040 GETA$:IFA$="Y"THENA$(X)=1:GOTO5050
5045 IFA$<>"N"THEN5040
5046 A$(X)=0
5050 NEXT:PRINT"■"
5055 V=1
5060 GOSUB40030:FORX=1TOA:IFA$(X)=0THEN5100
5070 A$(V)=A$(X):C$(V)=C$(X):FORY=1TO3:B$(Y,V)=B$(Y,X):NEXT
5080 V=V+1
5100 NEXT:A=V-1:GOTO50
5199 REM
6000 REM ***** RUN EXAM *****
6001 REM
6010 SC=0:FORX=1TOA:PRINT"■QUESTION"X" )"A$(X):FORY=1TO3:PRINTCHR$(Y+64)")"B$(Y,X):NEXT
6020 PRINT"■■A, B, OR C ";:POKE158,0
6030 GETA$:IFA$<"A"ORA$>"C"THEN6030
6040 PRINTA$:IFA$=C$(X)THEN6140
6050 PRINT"■■WRONG!"
6060 PRINT"■THE ANSWER IS "B$((ASC(C$(X))-64),X)" ("C$(X)")"
6070 GOTO6150
6140 SC=SC+1:PRINT"■■CORRECT ":PRINT"■YOU NOW HAVE"SC"QUESTIONS RIGHT"
6150 FORP=1TO3000:NEXT:NEXT
6160 PRINT"■■THAT IS THE END OF THE TEST"
6165 PRINT"■YOU GOT"SC"OUT OF"A"RIGHT"
6170 PRINT"■■■PRESS [SPACE] TO RETURN TO CHOICES":POKE158,0
6180 GETA$:IFA$<>" "THEN6180
6190 GOTO50
10000 FORP=1TO2000:NEXT:RETURN
```

MZ-80K Designer

by Norman Webster

```
1 PRINT"■":GOSUB20100:GOSUB9000:GOSUB11000
2 S=0
3 PRINT"■"
4 GOSUB10000
100 X=53409:P=202
110 GETA$:IFA$=""THEN110
120 IF A$="▄" THEN500
125 IF A$="▚" THEN510
130 IF A$="▐" THEN520
140 IF A$="▌" THEN530
141 IF A$="▁" THEN540
142 IF A$="▀" THEN550
143 IF A$="▔" THEN570
144 IF A$="×" THEN600
150 IF A$="S" THEN310
155 IF A$="E" THEN2
156 IF A$="0" THENPOKE X,0:GOTO309
157 IFA$="F"THEN 1
158 S=T(ASC(A$))
309 GOTO110
310 K=53248
315 WOPEN
320 B$=""
325 FORI=0TO22
330 FORJ=0TO39
332 Z$=CHR$(PEEK(K+(I*40)+J))
333 IF Z$="" THEN Z$=" "
339 B$=B$+Z$
340 NEXT J
345 PRINT#T B$:B$=""
350 NEXT I
360 CLOSE
500 IFPEEK(X-1)=163THEN110
505 POKEX-1,196:POKEX,S:X=X-1
507 GOTO110
510 IFPEEK(X+1)=163THEN110
515 POKEX+1,195:POKEX,S:X=X+1
517 GOTO110
520 IFPEEK(X+40)=163THEN110
525 POKEX+40,193:POKEX,S:X=X+40
527 GOTO110
530 IF PEEK(X-40)=163THEN110
535 POKEX-40,194:POKEX,S:X=X-40
536 GOTO110
540 IFPEEK(X+39)=163THEN110
545 POKEX+39,193:POKEX,S:X=X+39
```


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PROGRAMS

```
546 GOTO110
550 IFPEEK(X-39)=163THEN110
555 POKEX-39,194:POKEX,S:X=X-39
560 GOTO110
570 IFPEEK(X-41)=163THEN110
575 POKEX-41,194:POKEX,S:X=X-41
580 GOTO110
600 IF PEEK(X+41)=163THEN110
605 POKEX+41,193:POKEX,S:X=X+41
610 GOTO110
630 GOTO110
9000 DIM T(255)
9010 FORI=1TO255
9020 READ T(I)
9030 NEXT
9035 RESTORE
9040 RETURN
9100 DATA0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
9110 DATA97,98,99,100,101,102,103,104,105,107,106,47,42,46,45,32,33,34
9120 DATA35,36,37,38,39,40,41,79,44,81,43,87,73,85,1,2,3,4,5,6,7,8,9,10
9130 DATA 11,12,13,14,15,16,17,18,19,20,21,22,23,24,25,26,82,89,84,80,69,199
9140 DATA 200,201,202,203,204,205,206,207,223,231,232,233,234,236,237,239,209
9150 DATA 210,211,212,213,214,215,216,217,218,219,220,221,222,67,0,189,157,177
9160 DATA 181,185,180,158,178,12,186,190,159,179,183,187,191,163,133,164,165
9170 DATA 166,148,135,136,156,130,152,132,146,144,131,145,129,154,151,147,149
9180 DATA 137,161,175,139,134,150,162,171,170,138,142,176,173,141,167,168,169
9190 DATA 143,140,174,172,155,160,153,188,184,0,59,58,112,60,113,90,61,67,86
9200 DATA 63,30,74,28,29,62,92,31,95,94,55,123,127,54,122,126,51,75,76,29,108
9210 DATA 91,120,65,53,52,116,48,56,117,57,77,111,110,50,119,118,114
9220 DATA 115,71,56,83,49,78,109,72,70,125,68,27,88,121,66,96
10000 PRINT"■■■
```

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With the Toolkit fitted you can use commands like RENUMBER, FIND, DELETE and AUTO to help you edit your program. Then when you're satisfied, just type !A to assemble your code. Don't worry, if you've made a silly mistake you will get an appropriate message!

When you want to save your source code it really is easy – because you can treat it just like a Basic program. You can even verify it, just to make sure. It doesn't matter whether you've got disks or cassette – you can even go from one to the other if you wish.

MIKRO comes with a helpful manual which gives simple examples and explanations: nevertheless we do recommend that you purchase a reference book on 6502 programming.

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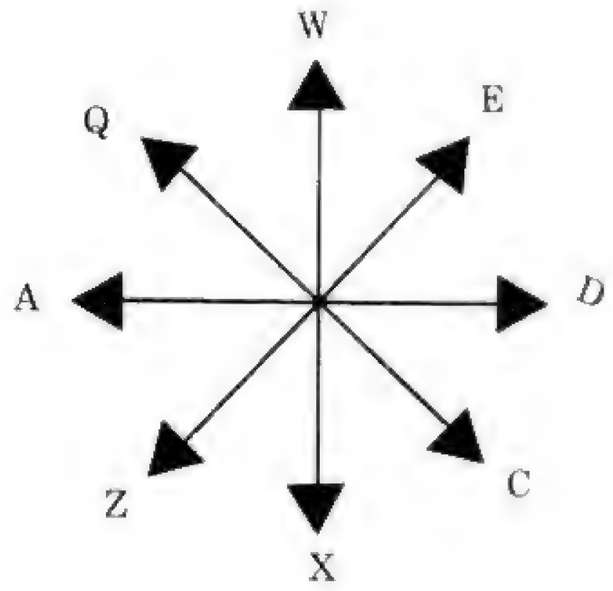
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PROGRAMS

ZX81 Sketch pad

by Neil Hutton

Our first ZX81 graphics program. The controls work like this:




```
10  SLOW
20  LET A£ = INKEY£
30  IF A£ = "C" OR A£ = "D" OR A£ =
    "E" THEN LET X = X+1
40  IF A£ = "Z" OR A£ = "A" OR A£ =
    "Q" THEN LET X = X—1
50  IF A£ = "Z" OR A£ = "X" OR A£ =
    "C" THEN LET Y = Y—1
60  IF A£ = "Q" OR A£ = "W" OR A£ =
    "E" THEN LET Y = Y+1
70  IF X < 0 OR X > 63 OR Y < 0 OR
    Y > 43 THEN GOTO 30
80  PLOT X, Y
90  GOTO 20
100 END
```

Program packing

The article by Morgan et al in March *PCW* in which the authors suggested that data could be stored most economically in the form of high base numbers seems to have overlooked the fact that, no matter how presented, the computer stores data as binary fields, and that characterisation uses extra space; indeed, the high base system is merely a circuitous attempt to return the data to the binary original.

To take the example given (the input from a 12 bit A/D converter) the data generated are already in a form that fits into a two byte field – no need to play games with numbers; store the data raw; they are already as condensed as any of the routines presented in the article could manage.

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PROGRAMS

bers in three 8-bit bytes (12x2=8x3). Thus:
1. Store the wholly used byte of the first number.
2. Store the wholly used byte of the second number.
3. Assemble the two remaining 4-bit sections into one byte.
4. Store the assembled byte.

The process is reversed when the stored data are later retrieved.

I am not familiar with Basic, so I cannot suggest any byte assembly/disassembly routines in that language, but the code in Figure 1 should run on a PET, or any other 6502 machine.

Derek Moody, Dorchester, Dorset

```
Code    Mnemonic
AD      LDA     ;To assemble two 4-bit remainders held in
YZ      YZ      ;address WXYZ (any location)
WX      WX      ;and address STUV into one byte,
29      AND     ;and put the result into WXYZ.
0F      0F
0A      ASL     ;ie, if WXYZ contains 05
0A      ASL     ;   and STUV contains 0A
0A      ASL     ;after running
0A      ASL     ;   WXYZ contains 5A
8D      STA
YZ      YZ
WX      WX      ;This subroutine is relocatable, and
AD      LDA     ;WXYZ and STUV may be anywhere in memory.
UV      UV
ST      ST
29      AND
0F      0F
18      CLC
6D      ADC
YZ      YZ
WX      WX
8D      STA
YZ      YZ
WX      WX
60      RTS     ;Return to calling routine.

Code    Mnemonic
AD      LDA     ;To disassemble the byte held in WXYZ and put the
YZ      YZ      ;results into addresses WXYZ and STUV.
WX      WX
AA      TAX     ;ie, if WXYZ contains B6.
29      AND     ;   After running,
F0      F0      ;      WXYZ contains 0B
4A      LSR     ;   and STUV contains 06
4A      LSR
4A      LSR
4A      LSR
8D      STA
YZ      YZ
WX      WX
8A      TXA
29      AND
0F      0F
8D      STA
UV      UV
ST      ST
60      RTS     ;Return.
```

MICRO CHESS

Continued from page 68

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The closing date for entries is 15 August 1981, although entries may be accepted after that date at the discretion of the organising committee.

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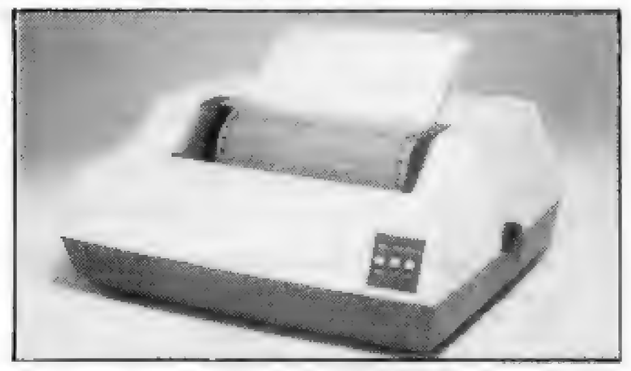
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The full rules were published in the June 1980 *PCW*.

All queries regarding the competition shall be addressed to: Second European Microcomputer Chess Championship, *Personal Computer World*, 14 Rathbone Place, London W1P 1DE.

CALCULATOR CORNER

Continued from page 130

an analysis of the flow structure shows that the reverse sequence will execute faster, providing $p(A+B+2C) > 2A+D$.

The beauty of Figure 3(b) is that if we modify the steps INV DSZ, GOTO 0 by replacing them with INV DSZ, INV N0P, MR0, INV x = 0, then the loop GOTO 0/LBL 0 will be followed once only and the reverse sequence will be faster if:
$p(A+B+2C) > A$ as $p \rightarrow 1$ this will invariably hold.

Operation	Execution time in seconds 10,000 steps	Comments
INV N0P	27.0	
+	123.2	1 + + = = ...
X	200.3	1 x x = = ...
Min 0	89.2	1 Min 0 . . . . .
MR 0	64.0	
M+0	167.2	1 M+0 . . . . .
GSB	10.7	Read time 10,000 steps
GOTO	11.8	Read time 10,000 steps

Fig 4. Comparison of execution and read times.

TOM'S TANDY PROBES PRANGS

Continued from page 95

would be possible for the program to be made available to insurance companies, probably on a time-sharing system, so that he can keep control over changes and updates without getting into immense administration hassles. In this way, insurance clerks would be able to check claim forms as they come in. The system could easily be modified to talk in terms of 'wet tarmac' instead of 'a coefficient of friction of 0.5', making things far more user-friendly.

And Tom knows that exactly the same principles could be applied to any sort of disaster, including shipping and aeroplanes. The potential to make a fortune there must be vast, but Tom's overriding concern is to have just enough money coming in so that he can continue his vital research into road safety. He tells me that when you've dug a few people out of crashes, all the fortunes in the world seem rather irrelevant.

SECRETS OF SYSTEMS ANALYSIS

Continued from page 83

be careful to store paper records properly and take copies of anything which might get lost; well, now you have to do this with your data files. You've probably forgotten by now that you had to learn how to look after paper with things written on it. Kids know that by the time they get to school. You'll remember learning about how to file bits of paper, even if you did find it a bit of a bore. Looking after computerised data is actually easier, even though you can't see what's happened to the data by looking at the disk.

Next month

Next month will be the final installment, covering the monitoring of a system in operation and listing a whole lot of books that you might like to read.

BLUDNERS

Beat you to it this month — page 104. fourth paragraph: there are many hundreds of possible states in noughts and crosses but not during the course of a single game. And the Acorn Atom Maze program published in April: lines 248, 256, 266 contain characters which look like colons (:) should be inverse backslashes. Finally, last month's UK101 Zor, line 180, contains POKE L — 44,96, but the minus sign didn't reproduce clearly on some copies.

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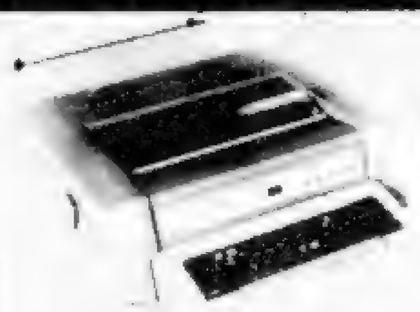
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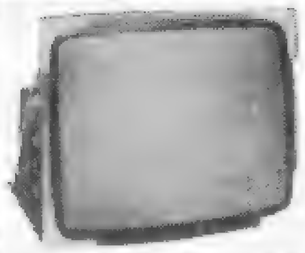


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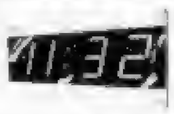


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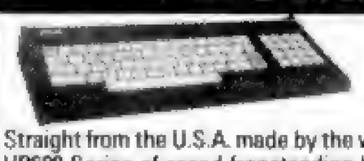
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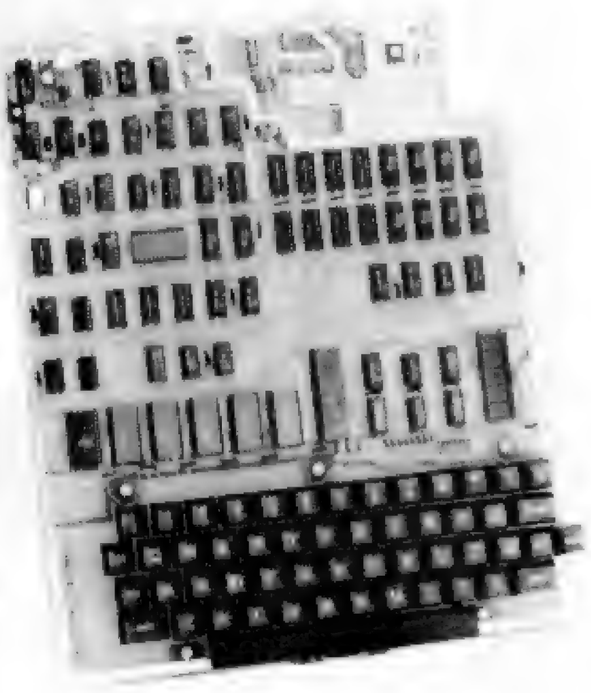
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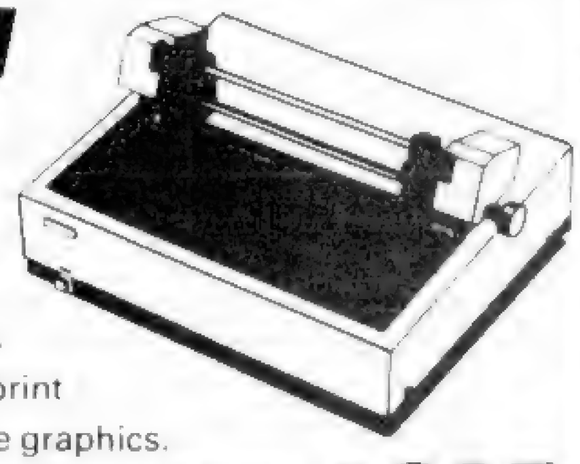
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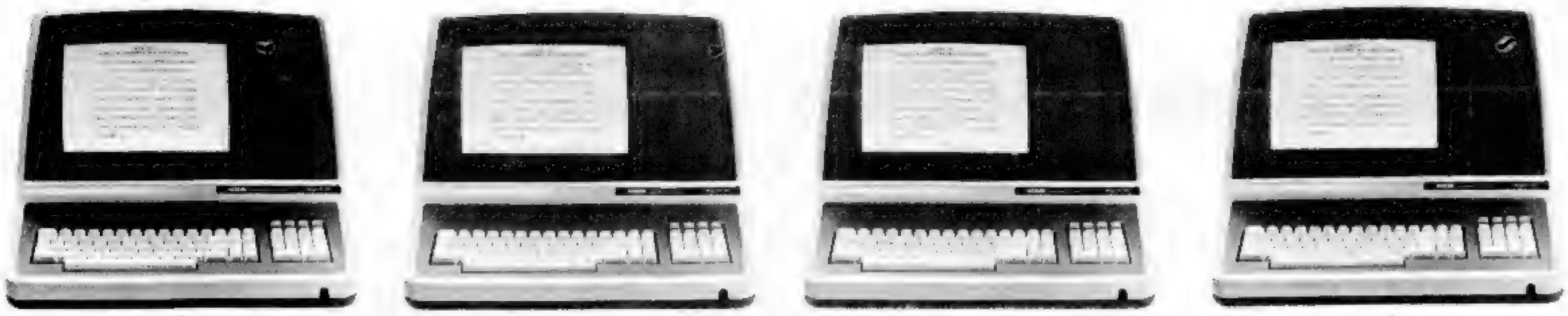
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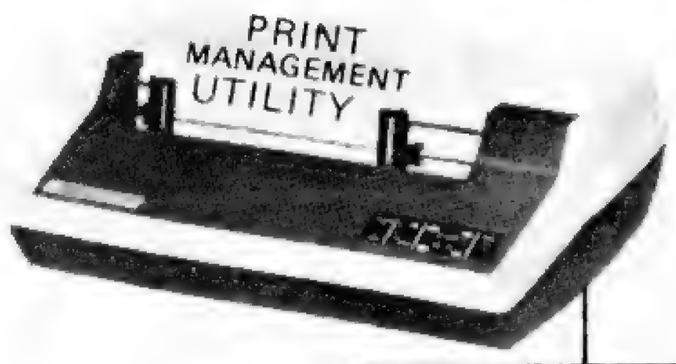
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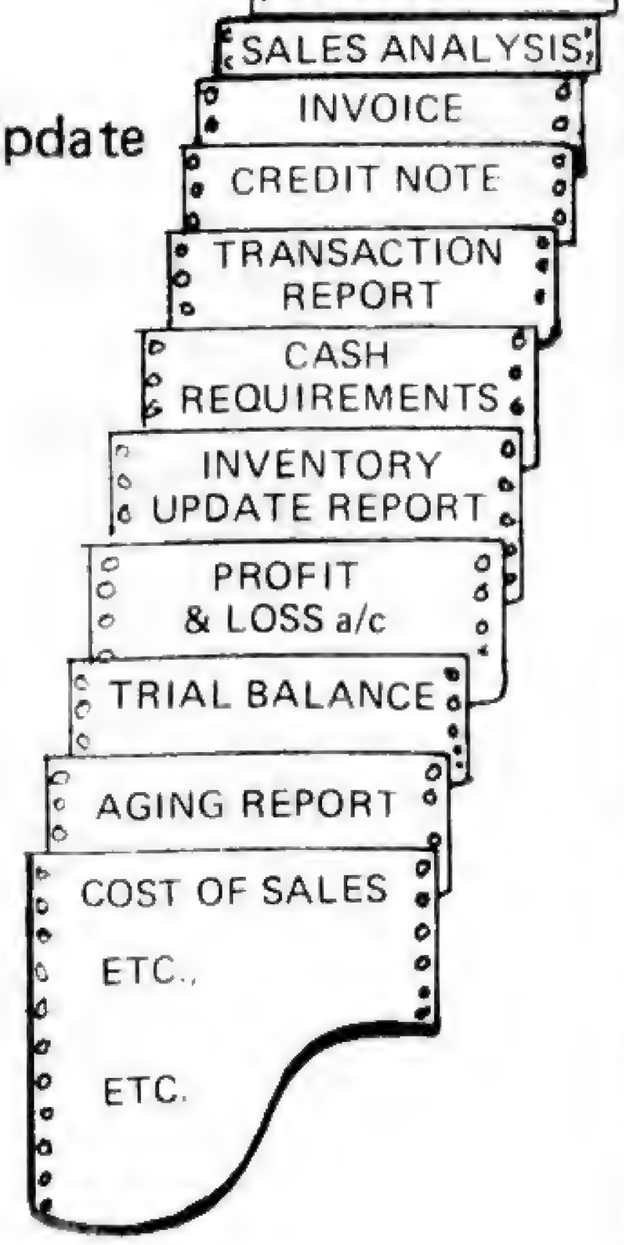
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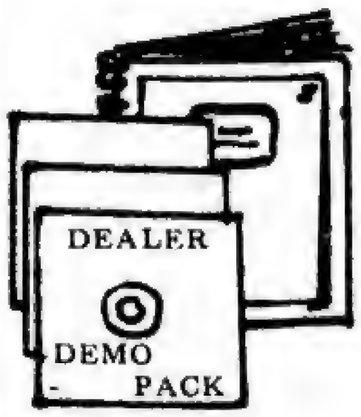


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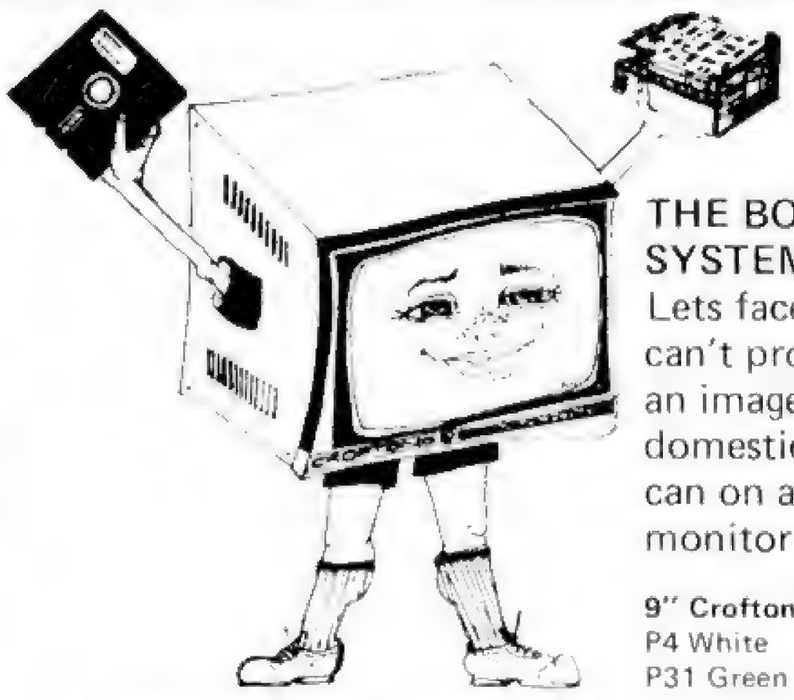
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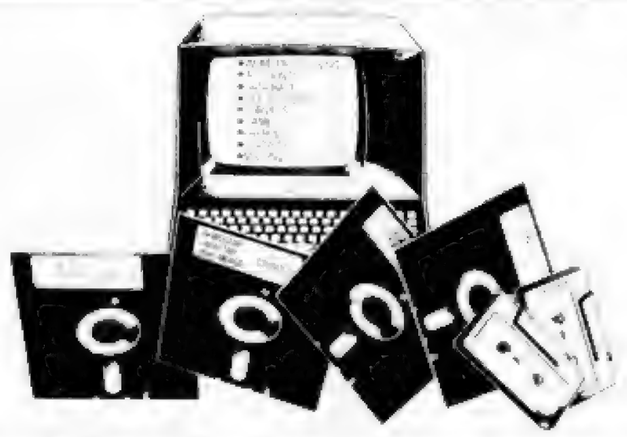
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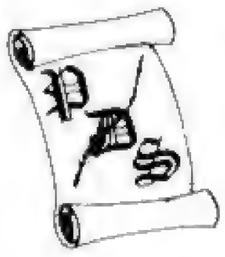
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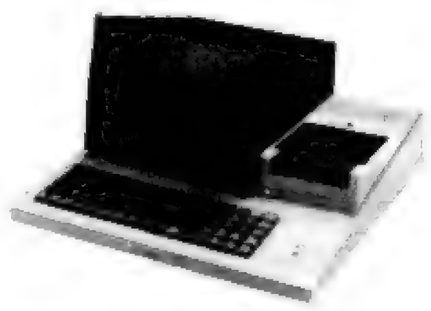
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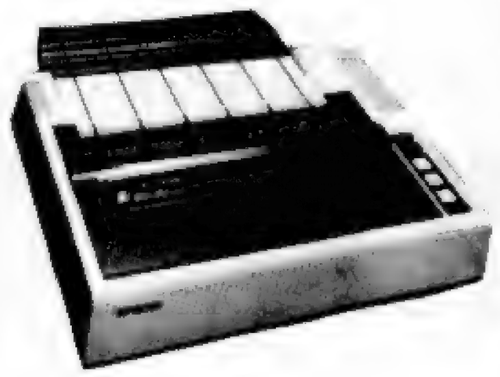
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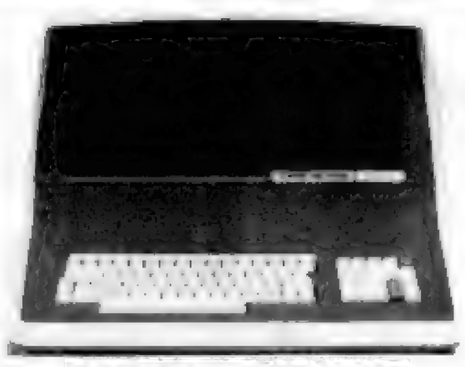
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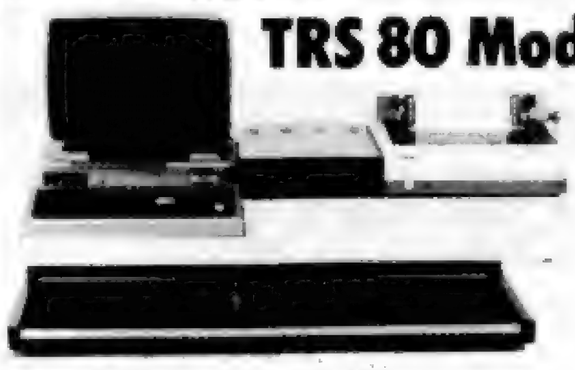


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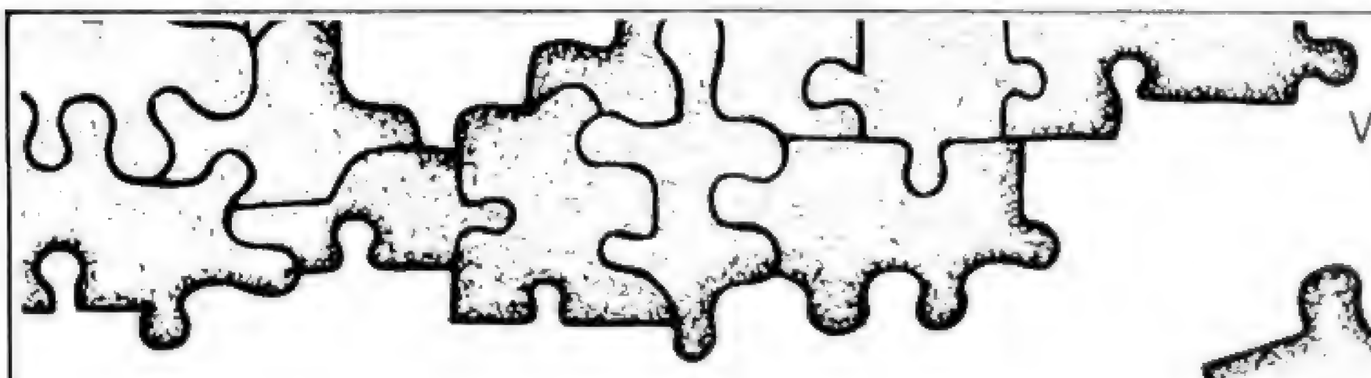
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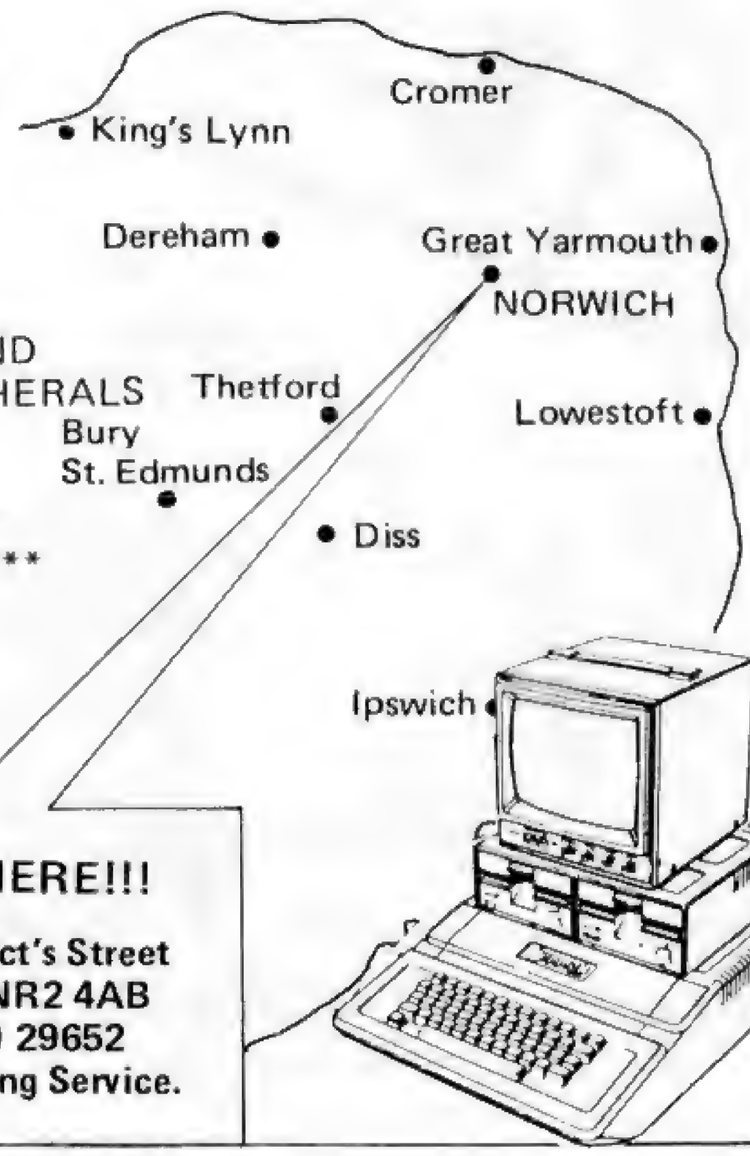
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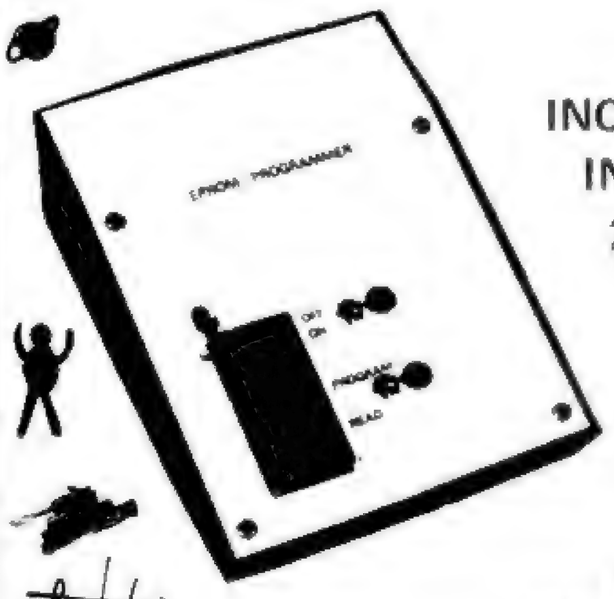
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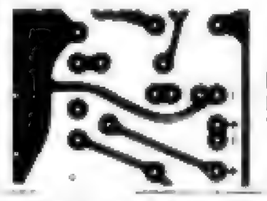
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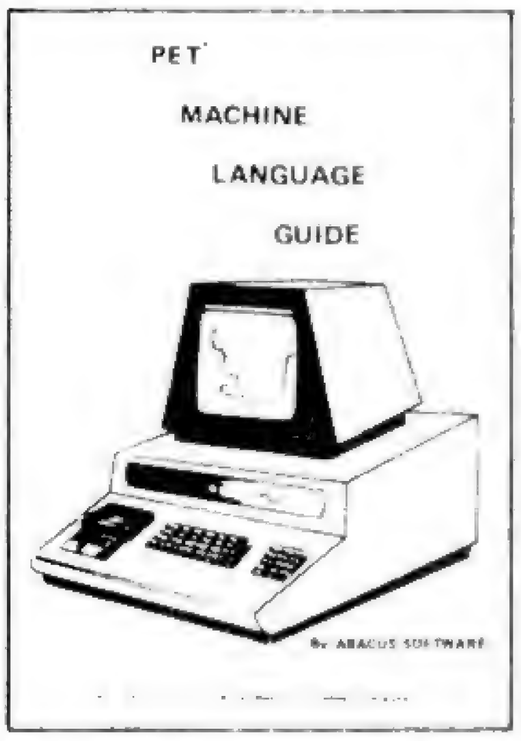
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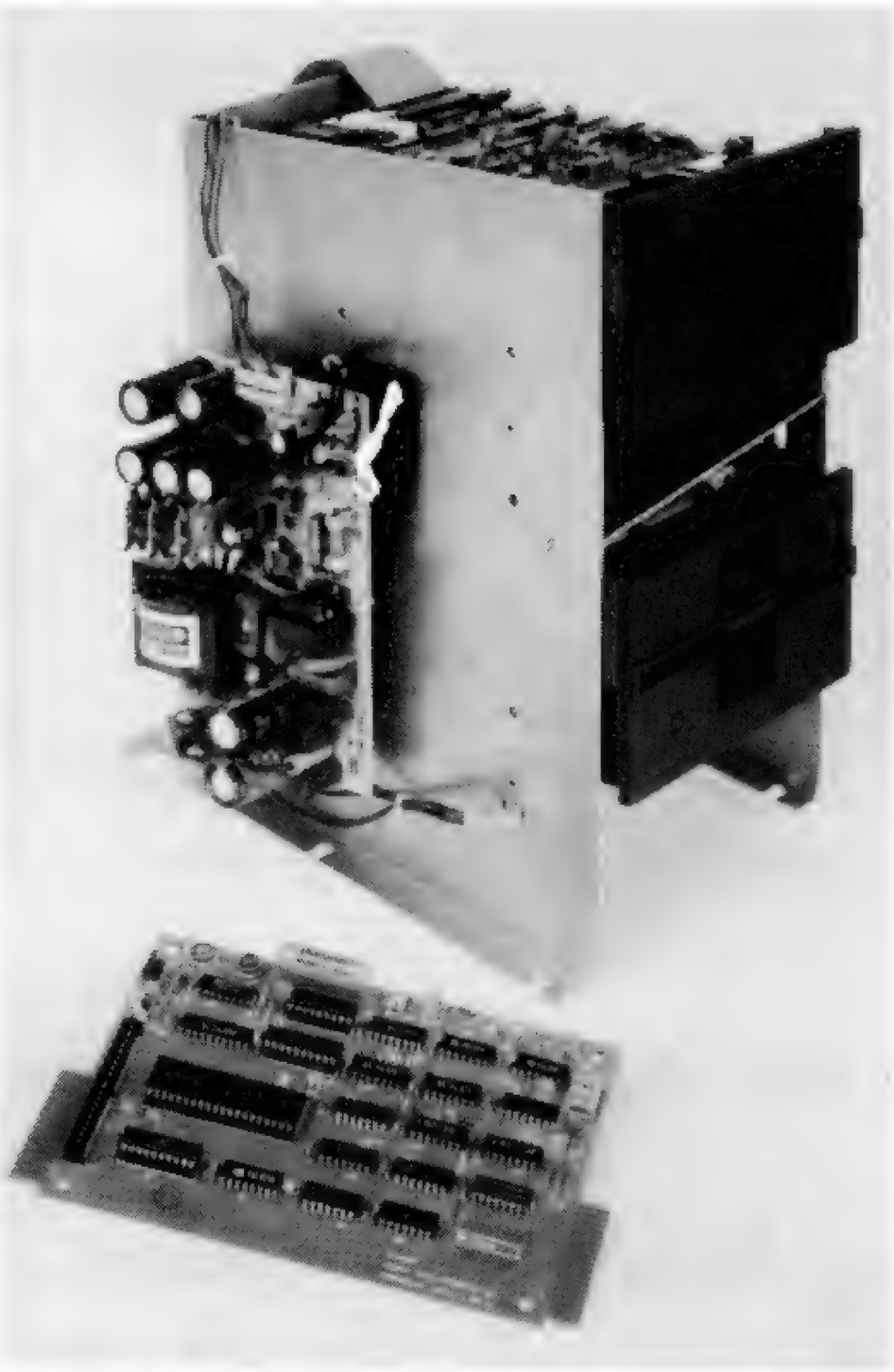
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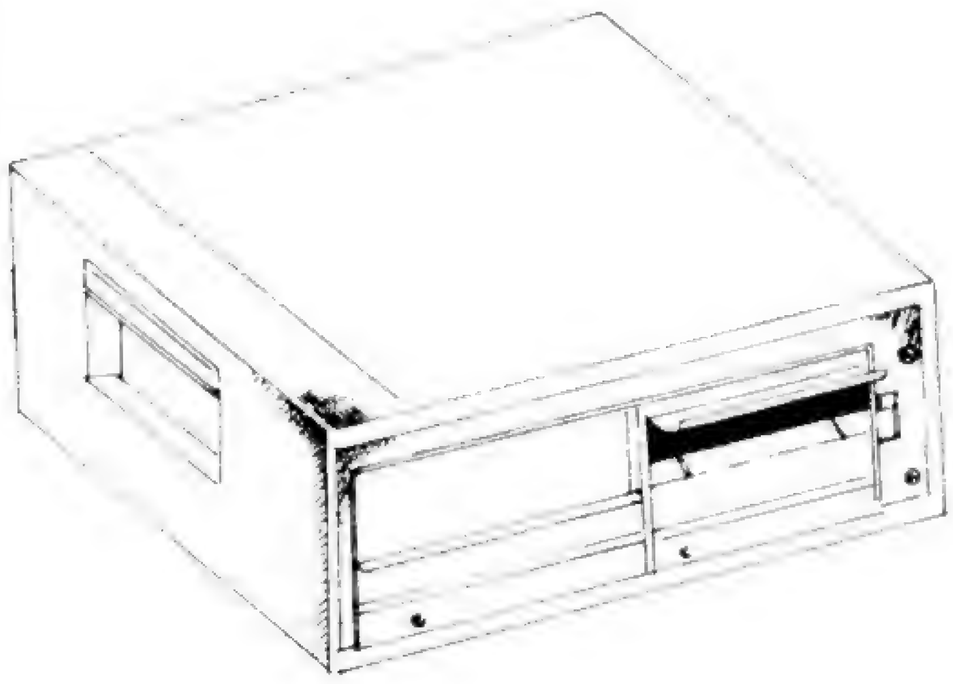
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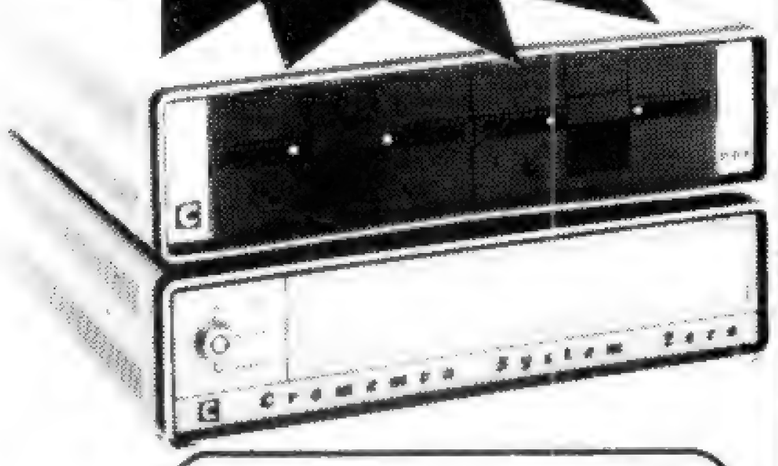
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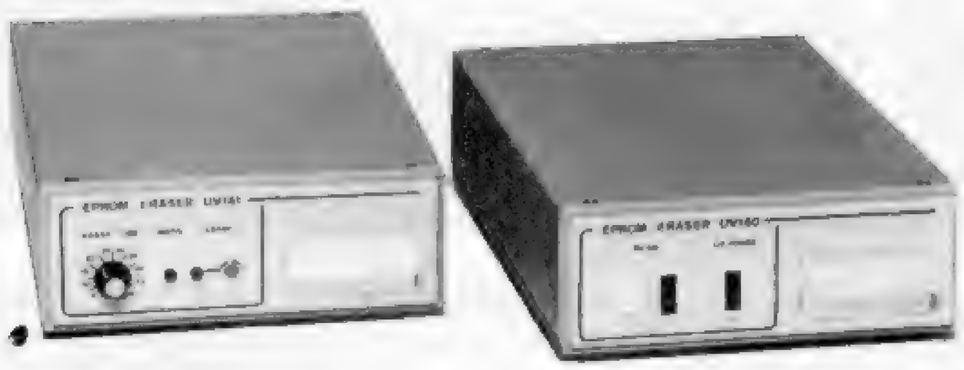
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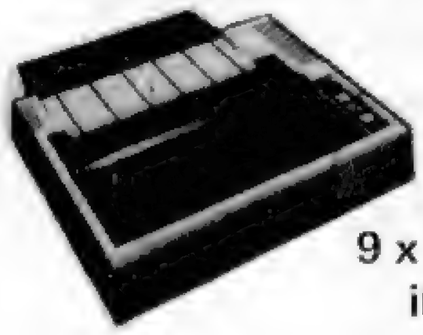
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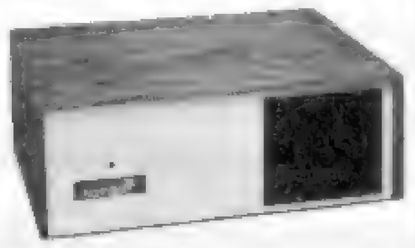
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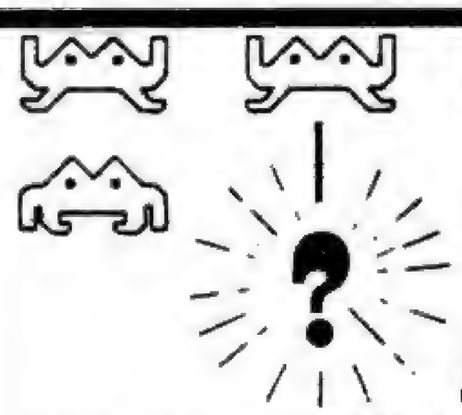
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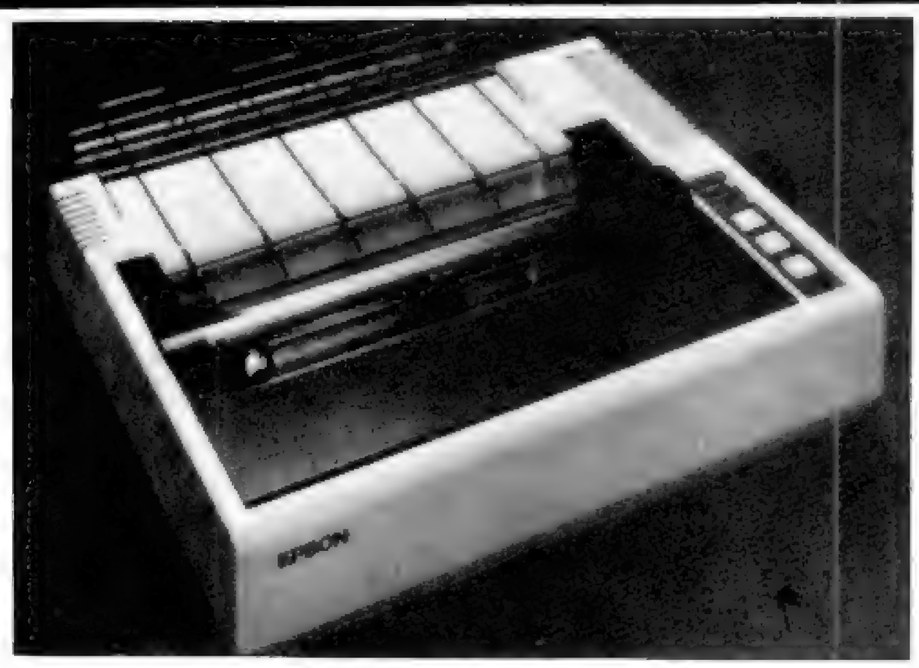
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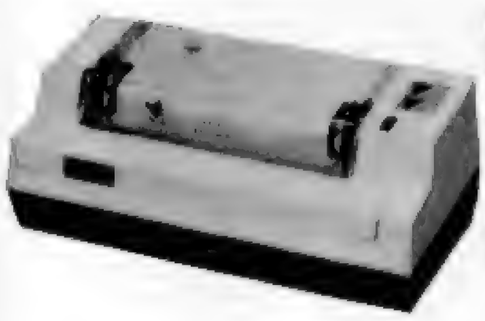
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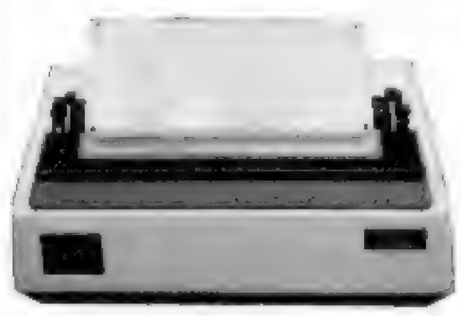


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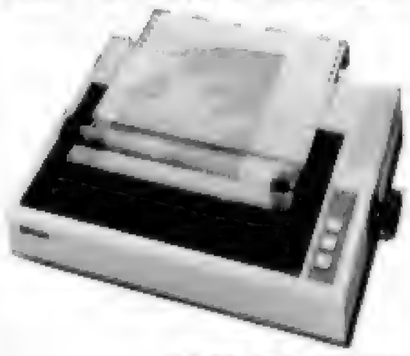


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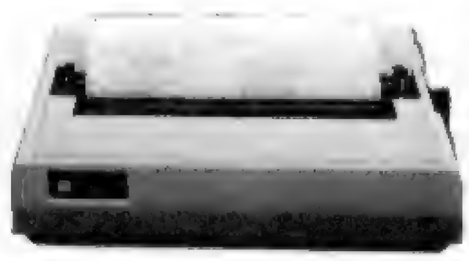


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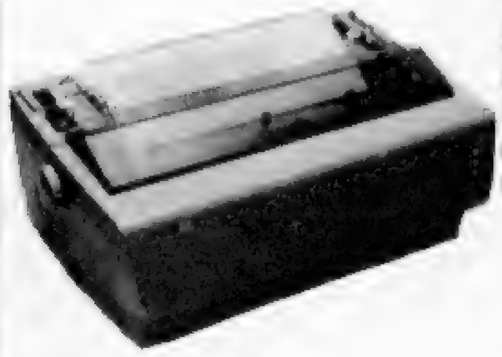


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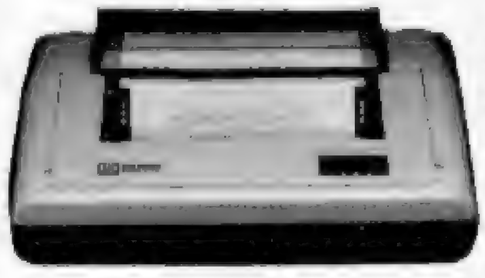


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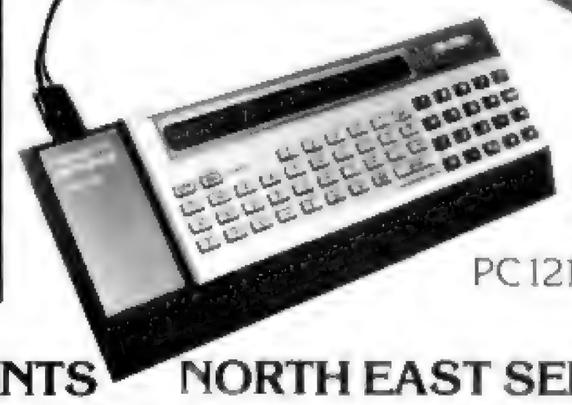
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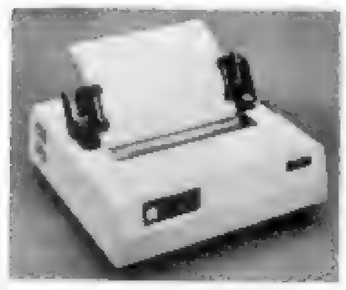
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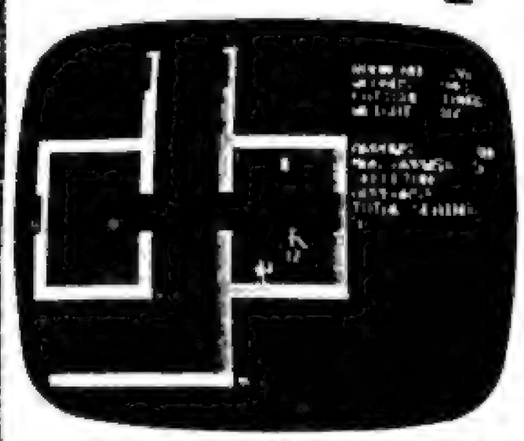
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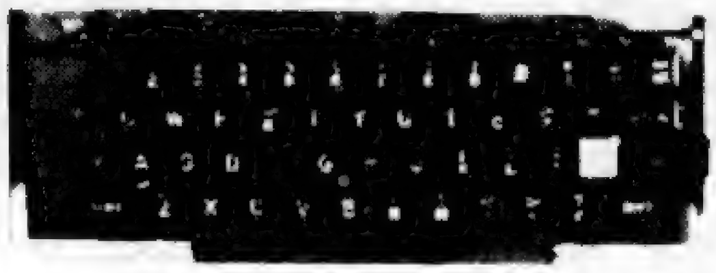
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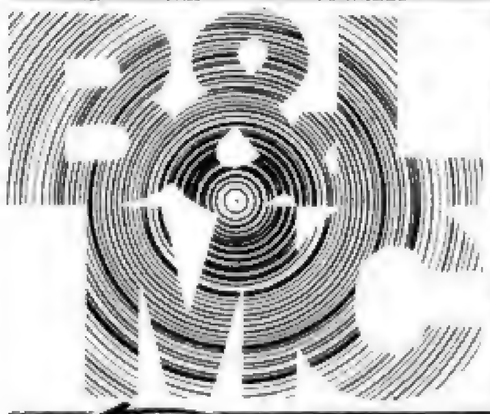
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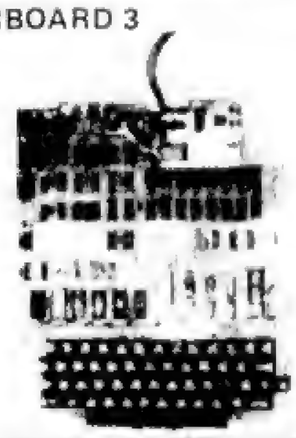
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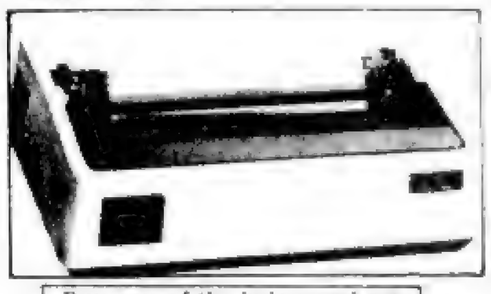
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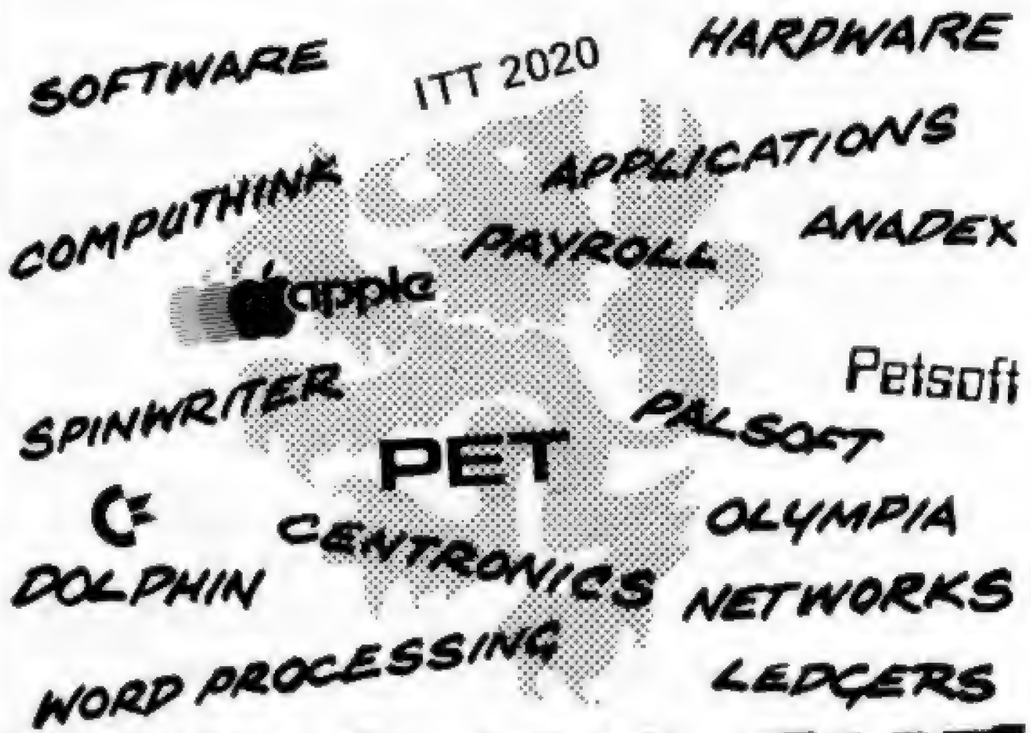
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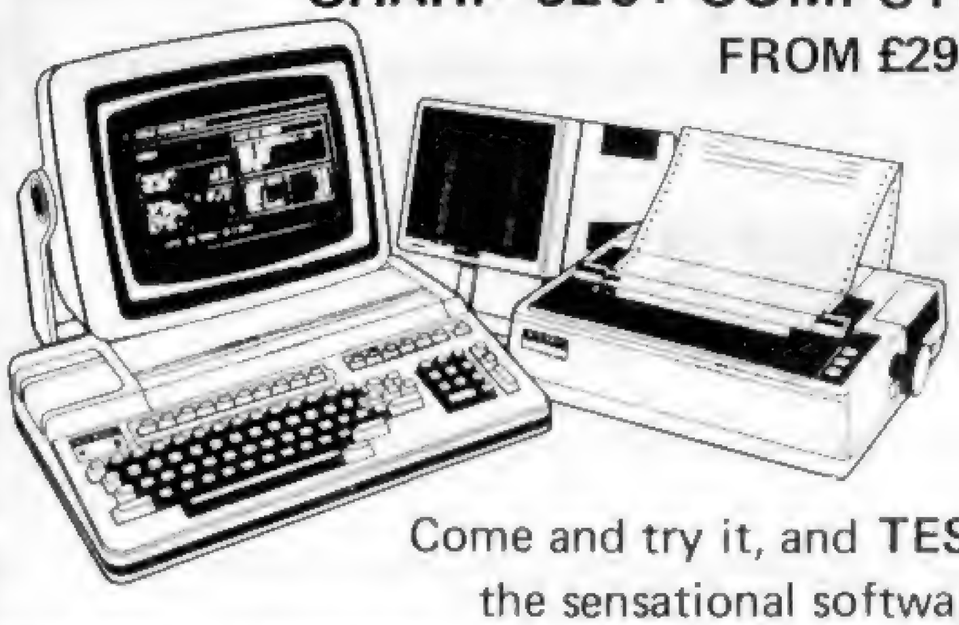
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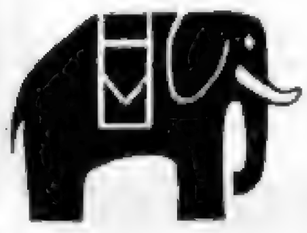
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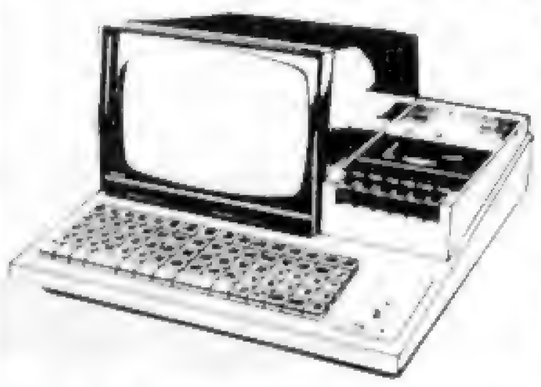
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It shows how you can obtain ultra-fast graphics, anywhere around the screen, manipulating by string concatenation.

Also there's a useful graphic block table.

The program gives the secret of being able to actually transfer data from one program to another and how to store it in memory for later use in another program.

You learn how to easily manipulate the cursor around the screen to position it just where you want.

Dissable procedure is explained, showing how to dissable either the whole keyboard or say the Break key. You are shown how to turn off the video. If you loose a program you can learn how to get it back. A keyobard de-bounce is given as is the routine to change Print statements to LPrint and much, much more.

This is not a simple program like the Video Genie program, for beginners, but for those really wanting to upgrade their programming techniques considerably.

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The Sinclair ZX80 is innovative and powerful. Now there's a magazine to help you get the most out of it.

Get in sync



SYNC magazine is different from other personal computing magazines. Not just different because it is about a unique computer, the Sinclair ZX80 (and kit version, the MicroAce). But different because of the creative and innovative philosophy of the editors.

A Fascinating Computer

The ZX80 doesn't have memory mapped video. Thus the screen goes blank when a key is pressed. To some reviewers this is a disadvantage. To our editors this is a challenge. One suggested that games could be written to take advantage of the screen blanking. For example, how about a game where characters and graphic symbols move around the screen while it is blanked? The object would be to crack the secret code governing the movements. Voila! A new game like Mastermind or Black Box uniquely for the ZX80.

We made some interesting discoveries soon after setting up the machine. For instance, the CHR$ function is not limited to a value between 0 and 255, but cycles repeatedly through the code. CHR$ (9) and CHR$ (265) will produce identical values. In other words, CHR$ operates in a MOD 256 fashion. We found that the "=" sign can be used several times on a single line, allowing the logical evaluation of variables. In the Sinclair, LET X=Y=Z=W is a valid expression.

Or consider the TL$ function which strips a string of its initial character. At first, we wondered what practical value it had. Then someone suggested it would be perfect for removing the dollar sign from numerical inputs.

Breakthroughs? Hardly. But indicative of the hints and kinds you'll find in every issue of **SYNC**. We intend to take the Sinclair to its limits and then push beyond, finding new tricks and tips, new applications, new ways to do what couldn't be done before. **SYNC** functions on many levels, with tutorials for the beginner and concepts that will keep the pros coming back for more. We'll show you how to duplicate commands available in other Basics. And, perhaps, how to do things that can't be done on other machines.

Many computer applications require that data be sorted. But did you realize there are over ten fundamentally different sorting algorithms? Many people settle for a simple bubble sort perhaps because it's described in so many programming manuals or because they've seen it in another program. However, sort routines such as heapsort or Shell-Metzner are over 100 times as fast as a bubble sort and may actually use less memory. Sure, 1K of memory isn't a lot to work with, but it can be stretched much further by using innovative, clever coding. You'll find this type of help in **SYNC**.

Lots of Games and Applications

Applications and software are the meat of **SYNC**. We recognize that along with useful, pragmatic applications, like financial analysis and graphing, you'll want games that are fun and challenging. In the charter issue of **SYNC** you'll find several games. Acey Ducey is a card game in which the dealer (the computer) deals two cards face up. You then have an option to bet depending upon whether you feel the next card dealt will have a value between the first two.

In Hurkle, another game in the charter issue, you have to find a happy little Hurkle who is hiding on a 10 X 10 grid. In response to your guesses, the Hurkle sends our a clue telling you in which direction to look next.

One of the most ancient forms of arithmetical puzzle is called a "boomerang." The oldest recorded example is that set down by Nicomachus in his *Arithmetica* around 100 A.D. You'll find a computer version of this puzzle in **SYNC**.

Hard-Hitting, Objective Evaluations

By selecting the ZX80 or MicroAce as your personal computer you've shown that you are an astute buyer looking for good performance, an innovative design and economical price. However, selecting software will not be easy. That's where **SYNC** comes in. **SYNC** evaluates software packages and other peripherals and doesn't just publish manufacturer descriptions. We put each package through its paces and give you an in-depth, objective report of its strengths and weaknesses.

SYNC is a Creative Computing publication. **Creative Computing** is the number 1 magazine of software and applications with nearly 100,000 circulation. The two most popular computer games books in the world, *Basic Computer Games* and *More Basic Computer Games* (combined sales over 500,000) are published by Creative Computing. Creative Computing Software manufactures over 150 software packages for six different personal computers.

Creative Computing, founded in 1974 by David Ahl, is a well-established firm committed to the future of personal computing. We expect the Sinclair ZX80 to be a highly successful computer and correspondingly, **SYNC** to be a respected and successful magazine.

Order SYNC Today

Right now we need all the help we can get. First of all, we'd like you to subscribe to **SYNC**. Subscriptions are posted by air directly from America and cost just £10 for one year (6 issues), £18 for two years (12 issues) or, if you really want to beat inflation, £25 for three years (18 issues). **SYNC** is available only by subscription; it is not on newstands. We guarantee your satisfaction or we will refund the unfulfilled portion of your subscription.

Needless to say, we can't fill up all the pages without your help. So send in your programs, articles, hints and tips. Remember, illustrations and screen photos make a piece much more interesting. Send in your reviews of peripherals and software too—but be warned: reviews must be in-depth and objective. We want you to respect what you read on the pages of **SYNC** so be honest and forthright in the material you send us. Of course we pay for contributions—just don't expect to retire on it.

The exploration has begun. Join us.

The magazine for Sinclair ZX80 users

SYNC

27 Andrew Close
Stoke Golding
Nuneaton CV13 6EL, England

The 4th Personal Computer World Show

10th-12th September 1981

This year's *PCW* show is all set to be bigger and more varied than ever before. It will be something like twice the size because we've now taken two floors of the hotel instead of last year's one. With one floor specialising in business, scientific and engineering applications and the other in home and hobby interests, this is definitely the show to see the micro in all its guises — from Space Invaders to word processors, from teaching applications (both floors) to company accounting. And, of course, everything you need to go with it — software, peripherals, power supplies and books — everything in fact to make the best of your personal computer world.

To make sure the show really goes with a swing, it will be organised so that you will know exactly where to go to find the stands that interest you most. Visitors will be given different coloured badges according to their interest. Of course, this won't stop you seeing the whole show, but it will mean that exhibitors can see at a glance who is just browsing and who is a potential buyer.

Of the 46 companies who had booked by the time we went to press, a few even managed to tell us what they'd be doing. Here's a selection:

The business section will comprise more than just computers. *Mind Your Own Business* magazine will be happy to help any baffled businessman who, faced with such an array of systems, doesn't know how to decide which one will be right for him or even what questions to ask the salesmen. For PET enthusiasts, 'Squire' Allason will be there with his *Printout* team to provide the latest lowdown on Commodore products.

Among the new products on show will be Commodore's new £200 baby, the VIC, which offers colour graphics and plugs into the domestic TV. Why not visit the stand and get some hands-on experience — and maybe even buy one? Roxburgh Printers will have a mysterious new product on display but at the moment they're keeping the details a closely guarded secret. Watch this space.

Molimerx knows a good thing when it sees one: ours is the only show that it's attending this year! This company specialises in software for all TRS-80 and Video Genie machines and is sole distributor for Acorn Software of Washington and of the LDOS operating system. With a bit of luck, some of Acorn Software's personnel will be on the stand to answer your questions.

Cetronic will have some interesting devices on its stand, in particular, the constant voltage transformers for personal computers and a shaft position encoder for use with the PET.

Portatel Conversions will have a wide range of Apple products on show and will be highlighting its unique high resolution graphics colour monitors dedicated to the Eurapple and operating without the need for a colour card.

Mapcon-authorised consultants MC Computers is another early booking. Its range of products includes a data acquisition system which can be used in a variety of ways, from measuring temperature in central heating systems to the monitoring of sheet metal pressing processes.

Among the exhibitors of business applications is Beta Systems who will have an interesting selection based on the Apple, including one for commodity brokers and another for hotel reservations. Tandy tells us that it will have the entire TRS-80 range there as well as many business packages.

Popping downstairs to the lower floor, you'll find a number of clubs and. of course, ComputerTown UK! — more about that next month. The European Microcomputer Chess Championship should make rivetting viewing, too. DAI has just announced that it will be awarding the first prize in our IYDP competition at the show. The lucky winner will be notified in mid-August.

Remember, there will be something for everybody at the 4th *PCW* Show. So, whatever your interests — whether you want to learn Basic, shoot silicon Martians or automate your payroll — make a note in your diary right now.

Companies booked at the time of going to press:

Beta Systems
Cetronic
Chromasonic
Community Computers
Comp Shop
Computer User Aids
Contour Computer Systems
Creative Computing
Data Applications
Easicomp
Elcomp
Feedback
A J Harding
Humac Computer Services
Ingersoll (Atari)
Intex Datalog
Kansas City Systems
Little Genius
London Computer Centre
Lowe Electronics
LP Enterprises (MPI)
Macronics
Maplin
March Communications
MC Computers
Microperipherals
Mind Your Own Business
Mine of Information
NEC Communications
Newbear
Personal Computers
Portatel Conversions
Printout magazine
Radio Shack
Research Machines
Roxburgh Printers
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Sinclair Research
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ST Commercial Systems
Tandy
Ties Investments
Vero Electronics
John Wiley

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CHIP CHAT

Just in case you haven't noticed, we have a new (improved) phone number: 01-631 1433. . . Speculation that Acorn has a 68000-based system in the pipeline was fuelled by the sight of Herman Hauser at a recent Motorola seminar, hob-nobbing with that company's technical bigwigs. . . Still on Acorn, Chris Curry calls the BBC micro the 'Beebon'. . . Malcolm Peltu returned from a Monte Carlo jaunt just in time to see one of the computer-controlled boards at Heathrow announce the arrival of a flight from Stuttfart. . . *PCW*'s editor went to hear Philippe Dreyfus explain France's information technology plans — the day following the election of a new President. . . Before making his name in software protection, barrister Alistair Nelman worked for a little-known firm of solicitors — see the letterhead reproduced elsewhere on this page. . . Latest buzzword from the States is 'snarf', as in 'we just snarf up data from Prestel'. . . Another Silicon Valley favourite is 'set verbosity to zero'. . . Mike Gurr spends his spare time visualising the havoc caused by computer-literate kids when they go to work and find that businesses haven't even got computers yet. . . Micromole Inc suggests we investigate a rumour that a certain Tangerine director has gone into the demolition business equipped with a brand-new Jaguar XJS. The score so far: a garden wall and a garage. Oddly, Micromole Inc enclosed an unprintable photo of *Toady's* Diego Rincon. . . Finally, in case you wondered about that odd cove pictured on page 70, he is Shino Zuka Iga no Kami — one of the 12 heroes of ancient Japan. The painting is by Kuni Yoshi Utagawa and it depicts the hero dressed up as a lance man — one of the shogi pieces.

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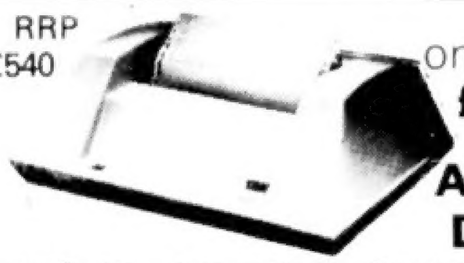
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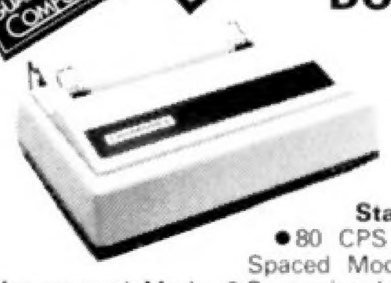
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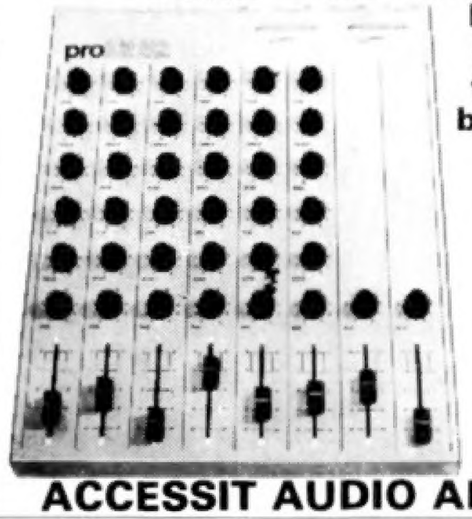
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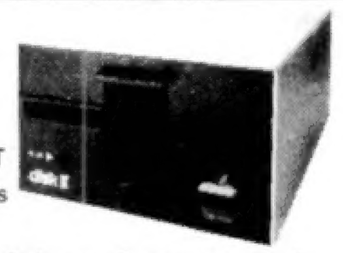
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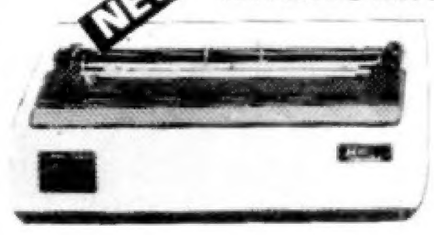


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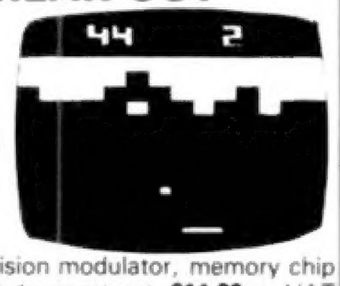
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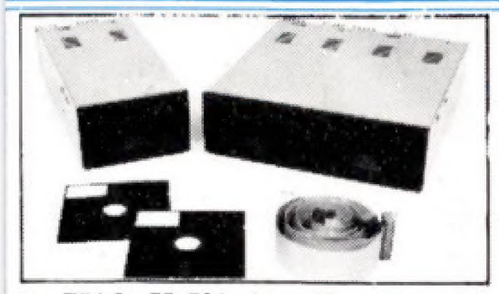
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